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SOURSAC (L.). **Étude de quelques maladies de la Laitue et des moyens de les prévenir ou de les combattre.** [A study of some diseases affecting Lettuce plants and of means to prevent or check them.]—Reprinted from *Congrès pour l'avancement des sciences*, Montpellier, 1922, in *Bull. Soc. Path. Vég. de France*, ix, 3, pp. 207 213, 1922.

In this paper three diseases of lettuce are discussed. A mild form of collar rot of lettuce and chicory plants due to *Sclerotinia libertiana* has been known in the Rousillon District (Eastern Pyrenees) for 12 to 14 years, but, no doubt owing to the introduction of more intensive cultivation, the disease has recently spread considerably, its development being further helped by the adoption of the trench system of irrigation, which transports the sclerotia from plot to plot. In the United States, where Poole has studied this disease on celery [see this *Review*, ii, p. 102], seedlings under glass are severely affected, but the loss in the field crop is insignificant. This is not the case in the Eastern Pyrenees, where glass is generally dispensed with, the sowings being made in the field, and the plants resulting from the thinning-out process being used for transplanting. Whilst in the United States the maximum intensity of the disease occurs at about the period when the young plants are ripe for transplanting, in France it reaches its height when the plants are two or three months old, the original sowings and transplantings being nearly equally affected. Light soils and wet years are favourable to the development of collar rot, which is also helped by the humid conditions and heavy nitrogenous fertilization connected with intensive cultivation. In 1921 the sowings made in September were severely attacked, those of November much less, and those of the following months were practically immune. Healthy lettuce transplanted to the immediate vicinity of infected plants in March remained free from the disease. The varieties in descending order of resistance are: cos lettuce of more or less straight growth, winter lettuce ('laitue d'hiver') of more or

less spreading growth, curly chicory ('chicorée frisée') and endive.

Attempts to germinate the sclerotia in various media have failed so far, probably because a sufficient resting period has not elapsed for their maturation. Measures for the control of the disease are now being tested.

Malformation of lettuce heads ('cabuchage') is a fairly frequent disease probably of physiological origin. The percentage of affected plants may reach 60 to 70. They are recognized by their folded and shrivelled leaves, which form loose and dwarfed heads.

Finally a second malformation, characterized by multiple branching, of cos lettuce plants of the variety 'romaine', is described. This condition prevents the formation of heads and renders the product unsaleable. The remedy for both these last-named diseases appears to be a rigorous selection of seed.

WINGARD (S. A.). **Yeast-spot of Lima Beans.**—*Phytopath.*, xii, 11, pp. 525–532, 4 figs., 1922.

A new disease of Lima bean seed (*Phaseolus lunatus*) was observed in October, 1921, in Virginia and has since been found to be rather prevalent and widely distributed in the State, as much as 60 per cent. of the crop being attacked in some cases.

The disease only occurs on the seed in the pod, causing numerous dark, sunken areas on the cotyledons; pods that appear to be quite healthy may contain badly affected seed. When the latter is attacked early it may die before ripening or remain undersized. The testa is usually unbroken, the infected spot being dark brown, somewhat sunken, and wrinkled, but sometimes it is ruptured, and crater-like lesions are then produced on the cotyledons. In these lesions, which are greyish-brown and granular, great masses of ascospores of a yeast and a small number of vegetative cells and young asci are found. The organism was readily isolated from several lots of beans, the platings invariably yielding pure cultures. It belongs to the genus *Nematospora* described by Peglion in 1901 (*Centralbl. für Bakt.*, Ab. 2, vii, p. 754). It differs in certain characters from the two species already described, and the author names it *N. phaseoli*, a full description being given.

The cells vary widely in form, from the elliptical and spherical types common in young cultures to mycelium-like strands, which bud at the cross walls; curiously shaped cells, like miniature tennis rackets, walking sticks, &c., are not uncommon after twenty-four hours growth. In size the elliptical cells measure 8 to 14 by 6 to 10 μ, the mature spherical cells 20 μ, and the mycelial strands 90 to 140 by 2·5 to 3·5 μ. Ascospores are produced in great numbers on bean seed and in favourable nutrient media. The asci are cylindrical with rounded ends, 60 to 85 by 10 to 12 μ; the ascospores, arranged in two groups of four, are 40 to 46 by 2·5 to 3 μ, slender, 1-septate, slightly ridged at the septum, with an acute apex, and a base extended into a slender, non-motile whip which is about one-and-a-quarter times as long as the spores. The ascospores germinate by the basal cell swelling to a sphere about 6 μ in diameter, from which either a mycelial strand is produced or

spherical cells are budded off. All the stages of the organism stain readily with ordinary stains, and it is Gram positive.

It grows well on media suitable for yeasts, and the cultural characters on six media are described. On beer wort agar the colony is convex, circular, with entire margin and smooth surface, opaque, dull, cream-coloured at first, then gradually turning to brown. Asci are produced in forty-eight to seventy-two hours, and after about three weeks the colony becomes surrounded by a mycelial growth on which a second crop of asci is borne. The optimum temperature in culture and for infection of Lima beans is probably about 30° C.

The pathogenicity of the organism has been demonstrated repeatedly in the greenhouse. Negative results were obtained when the pods were sprayed with a water suspension of the organism or smeared with a pure culture, but the seed was readily infected when the pods were inoculated through punctures. The symptoms become evident within two or three days of inoculation, and are quite conspicuous within seven to ten days. The organism was not pathogenic on garden peas and only weakly parasitic on tomatoes.

Jones (S. G.). **A bacterial disease of Turnip (Brassica napus).**—*Journ. Agric. Science*, xii, 3, pp. 292–305, 1 pl., 1922.

A disease of the white turnip has of recent years made its appearance in North Wales, especially on land treated with lime or a heavy dressing of nitrogenous fertilizers.

From a casual glance affected plants looked perfectly healthy, but on closer examination it was seen that the very young leaves at the centre of the crown had been destroyed, forming a tiny wound which the fully expanded leaves effectively concealed, so that the extent of the damage was often only revealed at lifting. In section a diseased root showed a flask-shaped, soft, putrid core, surrounded by a brown zone of healthy tissue. Sometimes the apical bud had been destroyed, and three to five vigorous secondary crowns developed in its place.

The causal organism was isolated by plating out in the usual way. Fresh isolations attacked turnip blocks very rapidly, but old cultures carried over for about twenty generations were found to have lost their pathogenicity.

Infections were attempted by immersing for an hour uninjured leaves (attached to the plant) in water containing the organism in suspension. No infection resulted, and the author is of the opinion that infection is preceded by mechanical injury (e.g. leaf cutting insects or slugs). The earliest signs of disease appeared in the young leaves, but attempts to infect them by inoculations gave negative results. When the tender foliage at the growing point was pinched off and the wound inoculated, infection always resulted and typical symptoms were produced, except that when the roots were of a dry, spongy texture, the diseased core was of uniform brown colour instead of whitish-grey, the difference in colour being due to oxidation.

Microscopical examination of affected tissues showed the cells to be comparatively isolated, the cell walls, however, remaining intact,

The disintegration of the tissues appeared to be occasioned by the solution of the middle lamella.

The separation of the by-products from the bacteria was attempted, and by adding chloroform to the liquid of a vigorous culture filtered through filter paper, a product was obtained which disintegrated thin slices of turnip but which was sterile.

The causal organism, which has one polar flagellum, is fully described. It has many characters in common with *Pseudomonas campestris* E. F. Smith and with *Bacillus oleracea* Harrison, but is clearly most nearly related to *Pseudomonas destructans* Potter, from which it differs chiefly by its mode of attack, by being Gram positive, by losing its virulence on repeated culturing, and by producing ammonia on some media. The author is of opinion that it is a varietal form of the latter.

Meier (F. C.) & Link (G. K. K.). **Bacterial spot of Cucumbers.**—*U. S. Dept. Agric. Circ.* 234, 5 pp., 1 pl., 1922.

This paper gives a short and popular description of two affections of cucumber, the bacterial spot of fruit and angular leaf spot, both of which occur frequently in the United States and also in Canada and Europe, and are due to the same cause, *Bacterium lacrymans*.

The disease first appears on the cucumber plant in the form of water soaked, translucent, round to irregular spots on the cotyledons. The later leaves show similar but angular spots which extend along the vein and which, under moist conditions, increase in number so as to cover the entire leaf, a white, gummy exudate swarming with bacteria frequently accompanying the spot. Within about eight days the spots become dry and white or tawny; subsequently the affected tissues may be knocked out, giving the foliage a ragged appearance. The stems and petioles are occasionally attacked, becoming water soaked and covered with a bacterial exudate. On the fruit, which may be affected in the field or become contaminated during the picking and packing processes, the spots first appear as minute, circular, water soaked areas, which later become conspicuous owing to the centres taking on a chalky white colour due to the drying and cracking of the affected tissues. The spots remain shallow, but they afford entrance to organisms which are capable of producing secondary rots, and heavy losses occur in transit from this cause. The disease may cause a stunting of growth, and the reduction in leaf surface often leads to a lowering of the yield.

Hot, dry weather tends to check the disease, but rains, especially if accompanied by wind, increase its spread.

The bacteria appear to be carried on the seed, and immersing the latter in mercuric chloride, 1 in 1,000, for five minutes, then washing thoroughly in water, gives a good control. Angular leaf spot can also be controlled by spraying with a 4–4–50 Bordeaux mixture, although the seed treatment is simpler and less expensive.

Higgins (B. B.). **The bacterial spot of Pepper.**—*Phytopath.*, xii, 11, pp. 501–516, 2 pl., 5 figs., 1922.

A bacterial disease of chilli pepper (*Capsicum annuum*) has been very destructive in Georgia since 1920. On the leaves the spots first appear as small, circular, pale-green pimples, somewhat raised

on the under surface, and usually with a slight depression on the upper. On old leaves, infection appears as dark green, water soaked spots. Usually the centre of the spot collapses in a few days, while the edges extend forming a circular or oblong, pale yellow or straw-coloured patch, 1 to 10 mm. across with a border of water soaked tissue which finally turns dark brown. Infected leaves fall, often becoming yellowish before doing so.

On the stem, the disease forms inconspicuous, raised cankers, and on the fruits more noticeable spots, which are pale green at first, but soon turn brown and become cracked and wart-like.

Isolations from infected spots yielded a yellow bacterium, the morphological, cultural, and physiological characters of which are fully described. It is a short rod, usually occurring singly or in pairs, rarely in chains. It is not very motile, but sometimes has a single polar flagellum. Capsules are present on certain media. It stains readily, but is Gram negative; grows moderately rapidly, is a strict aerobe, and liquefies gelatine. On beef extract agar with 3 per cent. dextrose or saccharose, the medium became first alkaline, then neutral, and finally acid, but with lactose it remained alkaline. The group number for this organism should be B. 211. 2222523.

Hundreds of plants have been successfully inoculated with this bacterium, and the latter re-isolated from them. The incubation period in summer is about 10 to 15 days. The exact mode of penetration of the leaf was not observed, but in early stages of infection slimy masses of bacteria were found in the stomatal cavities and adjoining intercellular spaces. The cells in contact with the mass swell and break the epidermis, the bacteria spreading in the intercellular spaces, forcing the cells apart, and finally killing them.

The identity of the organism is still uncertain. It resembles those isolated from tomatoes by Miss Doidge in South Africa and by Gardner and Hendrick in Indiana, but a comparative study of the three organisms is necessary.

The bacteria appear to be carried on the seed. Mercuric chloride (1 in 1,000) was quite effective in controlling the disease, but was liable to do severe damage to the seed, whilst spraying four times in the field with Bordeaux mixture reduced the infection considerably but did not give complete control.

Montemartini (L.). **L'applicazione degli Articoli 6 e 7 della Convenzione internazionale di Roma 4 marzo 1914 contro le malattie delle piante.** [The application of Articles 6 and 7 of the International Convention of Rome of 4th March 1914 against the diseases of plants.]—*Riv. Pat. Veg.*, xii, 1-2, pp. 1-7, 1922.

In this paper the author enumerates the difficulties connected with the practical application of Articles 6 and 7 of the International Convention for the Prevention of Plant Diseases signed at Rome in 1914.

Article 6 gives each signatory State the right to restrict the entry of plants covered by the Convention to certain selected places, and Article 7 provides for the inspection of the imported material and specifies the sanctions to be applied in case of disease being found, contrary to the certificate accompanying the consignment. In such

a case the consignment is either returned or destroyed by fire at the exporter's expense, and the latter's Government is immediately advised of the steps taken.

From experience gained at the Milan office, the author questions the practical utility of these measures, chiefly owing to the extreme difficulty of satisfactory inspection. It is contended that it is impossible to examine the material as minutely as the nature of the case demands, and that the healthy state of part of a consignment does not warrant the conclusion that the remainder is fit to pass the frontier. There is also the packing to be considered; this is very complicated in some cases, such as orchids, and requires technical skill in handling which is not available at the Customs. In the case of bulbs packed in boxes the difficulties are even greater, as in practice it is impossible to examine them one by one. Some parasites are hidden in the plant tissues and do not reach their full development on the surface until the last stages of the growth of the host. Others, such as *Septoria* [*apii*] on celery and *Phoma* [*betae*] and *Cercospora* [*beticola*] on beet, are seed-borne and invisible; others, again, are disseminated by the wind and inspection is powerless to prevent them from invading a country. The disinfection of all material sent would not be practicable for technical reasons.

The author concludes that the only effective remedy is increased vigilance on the part of each individual State within its own borders, which alone can make possible the prompt detection and eradication of plant diseases; and this must be supported by strengthening the frontier organization designed to prevent the entry of undesirable material.

Nevertheless, he thinks that the Articles under discussion should be retained for cases in which the examination of one sample makes a deduction as to the state of the remainder reasonably certain.

BIERS (P. M.). **Le Polyporus (Ungulina) inzengae de Not., parasite du Peuplier.** [*Polyporus (Ungulina) inzengae* de Not., parasitic on the Poplar.]—*Bull. Soc. Path. Vég. de France*, ix, 3, pp. 166–168, 1922.

At Parc St. Maur (Seine), France, a black poplar tree (*Populus nigra*) was observed to undergo a gradual process of decay, lasting for several years, and finally to die. The stem was covered with the fructifications of *Polyporus* (*Ungulina*) *inzengae* [*Fomes fomentarius*]. Several subsequent observations on other poplars bearing the same fungus support the view that this species acts as a true parasite, entrance being probably gained, in the cases seen, through wounds caused by clumsy pruning. Its development on the poplar is slow, and external evidence of its presence is only visible in the last stages of the disease.

FERDINANDSEN (C.). **Det plantepatologiske Arbejde i Danmark.** [Phytopathological work in Denmark.]—Reprinted from *Nordisk Jordbruksforskning*, pp. 333–351, 1922.

The author gives an interesting account of the origin and development of work on the diseases of plants in Denmark. The headquarters of the Danish Plant Protection Service, a branch of the State Agricultural Experiment Board, are situated at Lyngby, ten

miles north of Copenhagen. The work is under the general supervision of the Director, and is organized in three separate divisions, engaged respectively in botanical research, including fungous, bacterial, and physiological diseases; zoological research; and extension work for the distribution in popular form of the results of investigations. By co-operation with various experiment stations and agricultural organizations, arrangements are also made to conduct experiments and collect useful data in all parts of the country. These data are used in the compilation of the 'Monthly Survey of Diseases of Agricultural and Horticultural Crops', which appears from April to November.

The work of the extension or information section comprises the issue of popular leaflets on the more general and familiar diseases, replying to simple queries, procuring phytopathological material for exhibitions, lecturing, journalistic work, and the arrangement of summer meetings, excursions, and so forth.

During the last few years the standard of seed purity has been greatly improved by the State Seed Testing Station, an institution which works in co-operation with the Plant Protection Service.

In 1903, after Rostrup had shown that the annual loss to Danish agriculture from black rust [*Puccinia graminis*] amounted to Kr. 10,000,000 [about £400,000 at present], the law of 1869 providing for the extermination of the barberry was put into effect. The second plant disease law, which was promulgated in 1921, is concerned with the export and import of potatoes and has been already noticed in this *Review* [i, p. 125].

Krankheiten und Beschädigungen der Kulturpflanzen im Jahre 1920. [Diseases and pests of cultivated plants in the year 1920.]—*Mitt. biol. Reichsanst. Land- und Forstwirtsch.*, 23, 110 pp., 1922.

In the introductory section of this report Dr. Schwartz states that the annual reports of the diseases and pests of cultivated plants, formerly included in the agricultural reports published by the Ministry of the Interior, will in future be brought out in an abbreviated form by the Biological Institute at Dahlem. The publication of the reports was interrupted by the war, and it was found impossible to include the period 1913 to 1919 in subsequent issues. The reports will be devoted mainly to the enumeration of diseases and pests occurring in Germany during the year, with special reference to their economic importance.

In the present report an attempt has been made for the first time to prepare cartographic surveys of the distribution and varying intensity of some of the more important pests and diseases. Such surveys are intended to afford a basis for the systematic investigation of the correlation between the incidence of any given pest or disease and the climatic and geological conditions of the district in which it occurs. The material thus collected will in its turn serve as a foundation for the scientific researches to be conducted at the newly-established Laboratory of Meteorology and Phenology in the Biological Institute. During the period under review this laboratory was engaged mainly in preliminary work connected with the organization of the National Phenological Service, but in future

the climatic conditions of the year and their influence on plant cultivation will be discussed in greater detail.

The abnormal drought which prevailed during the summer of 1920 was responsible for the very poor keeping quality of the potatoes, while in some places the storage of damp tubers owing to the rainy weather at harvest time caused decay. In the province of Oldenburg the very heavy frosts which occurred in October 1919 completely interrupted the sowing of autumn seed, with the consequence that germination was greatly retarded. A further sequel to this delay was a very severe attack of stripe disease [*Helminthosporium gramineum*] on barley sown just before the frost, 60 per cent. of the crop often being infected, while Lochow's Petkus winter rye suffered to such a degree from the snow fungus [*Fusarium nivale*] that only one-third of the stand was left by the spring.

In the special section dealing with the fungous and physiological diseases of economic crops, for which Dr. H. Pape is responsible, only those diseases are referred to which were unusually destructive, or of rare occurrence, or which presented special points of scientific interest. Amongst the numerous records the following may be mentioned:

CEREALS. Almost all the plant protection head-quarters reported losses from bunt of wheat (*Tilletia tritici*), which was particularly severe in Saxony. Loose smut of oats (*Ustilago avenae*) was also very prevalent, the attack in Pomerania being the worst ever experienced. The stripe and spot diseases of barley (*Helminthosporium gramineum* and *H. teres*) appear to be on the increase from year to year. The losses reported frequently amounted to 20 or 30 per cent. and even exceeded 60 per cent. of the crops in some cases. Numerous reports of damage from cereal foot rots (*Leptosphaeria herpotrichoides, Ophiobolus herpotrichus*, and *Fusarium* spp.) were also received.

In Westphalia the rye crops on sand and sandy loam suffered from an excessive concentration of acid in the soil as a result of the dry weather in March. Oats were also affected, and in the manufacturing districts the phenomenon was wrongly attributed to sulphuric acid injury. The plant protection experts consider that the withdrawal of lime from the soil in these cases was correlated with altered biological conditions due to lack of water.

POTATOES. Blackleg [*Bacillus atrosepticus*] was reported from nearly all parts of the country, while bacterial soft rot of the tubers was particularly prevalent in Hesse-Nassau and Bavaria. Late blight (*Phytophthora infestans*) was severe and widely distributed. Wart disease (*Chrysophlyctis endobiotica*) [*Synchytrium endobioticum*] gained a foothold in several new districts during the year, and was reported from the following localities: Rhine Provinces, Westphalia, Hanover, Schleswig-Holstein, Hamburg, Lübeck, Mecklenburg, Brandenburg, Silesia, Saxe-Weimar, Eisenach, Saxe-Meinigen, and Saxe-Gotha. Leaf roll was widely distributed, while 'Kräuselkrankheit' was reported only from Lübeck and Oldenburg and mosaic disease from Munster [Westphalia].

ROOTS. Tip rot (*Bacillus bussei* and *B. lacerans*) occurred severely in Pomerania, especially on swedes. Root rot of beets (*Pythium de Baryanum, Phoma betae*, and *Aphanomyces laevis*) was prevalent

in many districts and completely destroyed certain fields in Oldenburg.

Vegetables. Cucumbers (outdoor and hothouse) were severely attacked by a bacteriosis [cause not specified] at Marienburg (West Prussia), and by downy mildew (*Pseudoperonospora cubensis*) in Wurtemberg. Gummosis (*Cladosporium cucumerinum*) was twice observed in the latter area, where blotch (*Corynespora melonis*) also occurred. Tomatoes in Wurtemberg were attacked by mildew (*Oidium lycopersici*) and a leaf spot caused by *Alternaria solani*, while near Hamburg *Ascochyta lycopersici* [*Didymella lycopersici*] assumed the character of an epidemic. *Sclerotinia libertiana* and *Septoria lycopersici* were each reported on this crop from two different localities. Peas in Oldenburg sustained heavy damage from wilt or St. Johannis disease (*Fusarium vasinfectum*). *Marssonia panattoniana* caused considerable losses in a salad garden in Saxony.

Fruit. Cherries were reported to be attacked by bacterial blight (*Bacillus spongiosus*) in only a single locality, but scab (*Fusicladium cerasi*) and brown rot (*Monilia*) were unusually prevalent. Apple mildew (*Podosphaera leucotricha*) was also exceptionally virulent and caused heavy damage. In Berlin this disease was observed as early as the end of March. *Peronospora rubi* caused some injury to raspberries in Oldenburg, the variety 'Superlative' being chiefly affected; while the raspberry cane blight, which may be caused either by *Didymella applanata* [see this *Review*, ii. p. 128] or by *Coniothyrium fuckelii*, was severe in Anhalt and Saxony.

American gooseberry mildew (*Sphaerotheca mors-uvae*) is steadily extending in Germany, and there is now scarcely a district free from it. In certain areas the harvest is stated to be decreasing year by year as a result of its attacks. *Polyporus ribis* was observed on gooseberries and currants in two localities.

Downy mildew of the vine (*Plasmopara viticola*) was severe all over the vine-growing districts. In Wurtemberg the attack approximated to the catastrophic epidemic of 1906. Powdery mildew (*Oidium tuckeri*) was also severe, while in Baden the 'rotbrenner' fungus (*Pseudopeziza tracheiphila*) caused a certain amount of damage.

Amongst the numerous other records of plant diseases, mention may be made of an outbreak of *Rhizoctonia violacea* on young pines, which destroyed some 4,000 plants in a nursery in Silesia; and of a die-back of the branches of elms, attributed by v. Tubeuf to over-blossoming, but which is of interest in view of the epidemic disease of the tree in Holland recently recorded [see this *Review*, ii. p. 92].

Jørstad (I.). **Beretning om plantesykdommer i land- og havebruket 1920–21. I. Landbruksvekster og grønnsaker.** [Report of agricultural and horticultural plant diseases during 1920–21. I. Cereal crops and vegetables.]—Reprinted from the *Report of the Minister of Agriculture*, 79 pp., 24 figs., 1922.

This report contains a survey of the principal diseases of cereal and vegetable crops observed in Norway during the years 1920 and 1921.

Besides notes on the common rusts, smuts, &c., of cereals, there is a full discussion on seed treatment. It is recommended that the seed of oats and barley should be treated with formalin in preference to copper sulphate, except in the case of stripe disease of barley (*Helminthosporium gramineum*) when copper sulphate should be used. Wheat and rye should be treated with copper sulphate instead of formalin if the seed cannot be sown immediately after disinfection. On the whole, copper sulphate appears to injure germination more than formalin, especially when the seed has been damaged in threshing. Mercurial fungicides have been extensively used during the last few years. They include 0·1 per cent. corrosive sublimate, uspulun, sublimoform (1:400 formalin + 0·1 per cent. corrosive sublimate), and fusariol (corrosive sublimate + copper sulphate). These preparations are highly toxic and are not injurious to germination. They are primarily intended for the control of *Fusarium* and stripe disease of barley, but are useful also in the suppression of smut.

Fusarium diseases of cereals are of considerable importance in Norway. The chief are the straw fusariose caused by *F. culmorum* and the snow mould caused by *Calonectria graminicola* in its conidial stage *Fusarium minimum* [*F. nivale*].

Bright speck disease of oats [see this *Review*, i, p. 421], due to an excess of alkali in the soil, can be successfully controlled by the application of manganese sulphate at the rate of 50 kg. per hect. A similar but much less serious disease has been observed on wheat and barley. In the latter case the spots are very small, arranged close together in rows, and dark brown in colour. This is presumably the disease formerly known as 'spot necrosis'.

Another apparently physiological disease of barley is known as the 'finger-print disease'. Brown spots appear at the end of June on leaves which are already yellowing, possibly as the result of an insect attack. The exact origin of the spots has not been ascertained, but they are in all probability non-parasitic.

Of interest are the records of *Typhula trifolii* on red clover (the first for thirteen years) and *Ascochyta pisi* causing a leaf spot of lucerne. Red clover and timothy (*Phleum pratense*) were also attacked by a dry spot disease which was apparently due to some physiological condition of the soil.

A very full account is given of wart disease of potatoes (*Synchytrium endobioticum*) and of the legislative and other measures adopted for its control in Norway. The disease extends over an area of about 30 by 10 km. in the region of Kristiansand. In 1921 the regulations in force since 1916, prohibiting the importation of potatoes from Great Britain, Ireland, and Germany, were extended to include Holland. The Ministry of Agriculture has further decreed (August 1921) that consignments of potatoes shall only be imported from other foreign countries when accompanied by a permit issued by the proper authorities of the country of origin vouching for the freedom of the consignments from wart disease.

Other potato diseases described, and in most cases illustrated, are the various types of scab, *Rhizoctonia solani*, *Sclerotinia libertiana*, blight (*Phytophthora infestans*), blackleg [*Bacillus atroseptieus*], ring bacterial disease, dry rot [*Fusarium caeruleum*], leaf roll, and mosaic.

Leaf mould or rust (*Cladosporium fulvum*), stem bacteriosis (*Bacillus solanacearum*), blossom end rot (a bacterial disease), and the black rot caused by *Phoma destructiva* and *Rhizoctonia solani*, were observed on tomatoes, the last-named not being serious. Beets were scabbed by *Actinomyces* sp. Club root (*Plasmodiophora brassicae*) occurred on cabbage and white mustard, soft rot (*Bacillus carotovorus*) on turnip, and brown rot (*Pseudomonas campestris*) was observed on all species of *Brassica*. On beans *Ascochyta boltshauseri* [*Stagonosporopsis hortensis*], *Bacterium phaseoli*, and mosaic were amongst the diseases reported. *Pythium de Baryanum* attacked seedlings of a number of different plants. Leaf spot of cucumbers (*Cladosporium cucumerinum*) did considerable damage and also attacked melons, both hothouse and outdoor plants being affected.

There are numerous other records of interest, and the report forms a useful guide to the crop diseases of Norway.

TEMPANY (H. A.). **Annual Report on the Department of Agriculture, Mauritius, for the year 1921,** 21 pp., 1922.

The Report contains the following references to matters of phytopathological interest. Root disease of sugar-cane occurred on one estate in the Pamplemousses area, but was suppressed by the treatment recommended by the Department of Agriculture. Other bacterial and fungous diseases of sugar-cane were rare, and mosaic disease has so far not been found in Mauritius.

Late planted potato fields were severely damaged by blight (*Phytophthora infestans*).

Field investigations on the 'smut' disease of filaos (*Casuarina equisetifolia*) were continued in conjunction with the Forest Department. Filao blanc was attacked by *Corticium salmonicolor*, reported for the first time on this host, though previously found attacking apples and pears.

Cultivated *Chenopodium* [goosefoot] at Réduit was attacked by downy mildew (*Peronospora* sp.).

Citrus plants at the Réduit Central Experiment Station were found to be infected by canker (*Pseudomonas citri*), and lime trees at Belle Rive and Pamplemousses were attacked by a specific bacillus which invaded the bark, causing gummosis of the trunk and the subsequent death of the trees.

Report on the Agricultural Department, Government of the Gold Coast, for the year 1921, 77 pp., 1922.

The reorganization of the department has led to the grouping of the two mycologists, two entomologists, and the chemist in a Research Branch at Aburi, Mr. R. H. Bunting, the Assistant Director for Research and Mycologist, being placed in general charge of the work of this branch. Mr. H. A. Dade joined the staff as Assistant Mycologist during the year.

The investigation of the new disease of cacao reported in 1919 under the name 'mealy pod' [a technical account of which is being prepared for publication elsewhere] was continued. It is caused by a fungus of considerable scientific interest, the systematic position of which was difficult to fix. Preliminary infection experiments

indicate that the organism is sometimes capable of infecting unwounded pods which have been detached from the tree, and that wounded or weak pods are much more liable to attack in the field than vigorous ones.

A severe epidemic of black pod disease of cacao [*Phytophthora faberi*] occurred on the banks of the Birrim River, causing a decay of 99 per cent. of the pods in some plantations. Characteristic sporangia were observed on numerous pods, both harvested and on the trees. The outbreak was probably due mainly to the failure to collect the pods during the previous slump in the local cacao market, though excessive moisture may have aggravated it. Passage of the fungus from affected pods to the stem on which they are borne, with resulting canker formation and liability to reinfect succeeding crops, was demonstrated, and the importance of removing all diseased pods clearly established. The disease may be controlled by proper drainage and cultivation, thinning out, and the removal of excessive shade. Ripe pods, healthy or diseased, should be removed from the trees, diseased tissue on the stems excised, the wounds tarred, and all diseased material burnt. Empty husks should be buried as soon as possible. A circular urging native producers to take active precautions against the spread of the disease has been distributed, but legislative measures will probably be necessary to ensure co-operative efforts in this direction.

The thread blights of permanent crops were investigated in the Kibbi district. Cacao trees planted in heavy, wet soil appeared to be particularly liable to white thread. The presence of horse-hair blight is injurious on account of its interference with the natural functions of the foliage, but the question of its parasitism has not been definitely decided. These diseases may be controlled by improving soil conditions (tillage, drainage, and the like) and by cutting out and burning all affected parts.

Cooks (C. H.). **Diseases of field and vegetable crops in the United States in 1921.**—*Plant Disease Bull. Supplement* 22, pp. 255–414, 21 maps, 1922.

This annual review of the diseases of field and vegetable crops in the United States has been prepared on the same lines as those of fruit and nut crops, and cereal and forage crops, already noticed [see this *Review*, i, pp. 376 and 424].

During the last few years the potato certification movement has been considerably extended in the United States and Canada, with the result that the progressive deterioration of potato varieties brought about by disease has been partially arrested. Reports from various States on the use of copper-lime dust as a substitute for liquid Bordeaux mixture showed that there is a consistent increase in yield of the dusted rows over checks. The increases, however, are somewhat smaller than those obtained from Bordeaux mixture. The experiments of 1922 indicate that copper-lime dusts afford ample protection against late blight, but that against tip burn, hopper burn, and flea beetles the protection is not so good as by spraying. Although in 1920 late blight was prevalent, the general high temperatures and drought prevailing in the early half of the growing season operated to check the spread of the disease

in 1921. Mosaic, leaf roll, and allied diseases continue to be of great interest to research workers, and at present occupy the attention of many investigators.

The diseases of tomatoes, sweet potatoes, beans, onions, cruciferous crops, and cucurbits are summarized, with notes on prevalence, distribution, losses, and any special points of interest. Sugar-cane mosaic is stated by Brandes to occur in all the sugar-producing districts of the world, with the possible exception of India. In the United States the distribution is restricted to Louisiana, Alabama, Georgia, Florida, and Mississippi.

Sections on the diseases of sugar beet, tobacco, and miscellaneous vegetable crops complete the *Bulletin*, which is a mine of valuable information.

MARTIN (G. H.). **Diseases of forest and shade trees, ornamental and miscellaneous plants in the United States in 1921:—** *Plant Disease Bull. Supplement* 23, pp. 415–488, 15 maps, 1922.

This summary has been compiled from reports furnished by collaborators in the various States, specialists in the offices of Forest Pathology and Blister Rust Control of the Bureau of Plant Industry, articles in botanical journals, and special reporters. Owing to the lack of available data it has been found necessary to issue the information in list form, with only a few scattered notes on the general distribution and prevalence of the disease mentioned.

Douglas fir (*Pseudotsuga taxifolia*) was very generally and severely attacked by *Trametes pini*, causing 'conk' rot which extends throughout the tree; *Polyporus schweinitzii*, producing red-brown butt rot; *Fomes laricis*, causing brown trunk rot; and *F. roseus*, the cause of yellow-brown top rot. These four fungi are responsible for practically all the decay occurring in the Douglas fir, which sometimes amounts to 50 per cent. of the stand or more.

White pine (*Pinus strobus*) suffers chiefly from the blister rust (*Cronartium ribicola*). The co-operation between the New England States, New York, Wisconsin, and Minnesota on the one hand, and the Bureau of Plant Industry on the other, which was in force from 1917 to 1921, resulted in the development of practical local control measures. The widespread application of the latter is the object of the continued co-operation between these States and the Federal Government. Special blister rust experts have been appointed by the Bureau of Plant Industry to work in co-operation with the State Forestry Departments and the State Agricultural Extension Divisions. Under average conditions the safeguarding of pine stands can be effected by the removal of currant and gooseberry bushes to a distance of 900 ft. Cultivated black currants, however, which are the most heavily infected of all the species of *Ribes*, have been known to transmit the disease to pines more than one and a half miles away.

Poplars, especially in Utah, are being rapidly destroyed by canker (*Cytospora chrysosperma*), which is widely distributed in the south-western States. The varieties affected are *Populus alba bolleana*, *P. nigra*, *P. carolina*, and *P. tremuloides*.

This annual publication of the United States Plant Disease Survey is particularly useful in bringing together the numerous

scattered records of parasitic fungi found on trees, shrubs, and ornamental plants during the year.

JARDINE (J. T.). **Director's Biennial Report: Oregon Agricultural Experiment Station, 1920–1922,** 104 pp., 1922.

In the Report of the Department of Botany and Plant Pathology (pp. 72–75), reference is made to several matters of phytopathological interest in Oregon.

Anthracnose of apples [*Neofabraea malicorticis*] is now being controlled by the use of Bordeaux mixture in one of the late codling moth sprays, thus effecting a saving of one spray application annually for 20,000 acres of bearing trees.

Tests carried out in 1921 demonstrated that excellent control of onion smut [*Urocystis cepulae*] on the most heavily contaminated beaver-dam soil could be secured by the use of formalin (1 oz. to 1 gall. water), provided a stream of not less than five-sixteenths of an inch in diameter is run into the furrow as the seed is dropped. In one plot so treated the yield amounted to 364 sacks per acre as against 88½ sacks in the untreated control.

The preliminary results of an investigation of the 'take-all' disease of wheat [*Ophiobolus cariceti*] in the Willamette Valley show that climatic conditions exercise a very great influence on the severity of the disease.

Co-operative experimental work with the Federal Department demonstrated the risk of seed injury from the ordinary formalin and copper sulphate dips used against bunt of wheat [*Tilletia*], and proved the value of a subsequent milk-of-lime bath to counteract much of the damage [see this *Review*, i, pp. 298, 378]. The results of further tests showed that practically no injury to wheat seed-grain occurs after dusting with powdered copper carbonate, which gives satisfactory bunt control. It is estimated that about 50,000 bushels of seed grain per annum are destroyed by injurious treatment in one county of Oregon alone.

Investigations of potato wilt [*Fusarium oxysporum* and *Verticillium albo-atrum*] have proved the value of crop rotation and field roguing in the control of the disease. During the growing season infection spreads from plant to plant underground, so that not only wilted plants themselves should be pulled up, but also those next in the row on either side.

Pears and apples in Oregon have been widely attacked by European canker [*Nectria galligena*], the diagnosis of which has been facilitated by the discovery of the early spore stage in young cankers [see this *Review*, i, p. 217]. The application of Bordeaux mixture previous to the autumn rainy season is beneficial, and there is reason to hope that the control of canker and anthracnose can be accomplished by one and the same application.

Астраханская Станция Защиты Растений от Вредителей. [Astrakhan Plant Protection Station.] pp. 1–26, 1922.

We have received the report on the work of this Station during 1921, from which the difficulties arising from lack of experienced personnel and shortage of material for combating insect and fungous diseases of cultivated plants are plainly apparent. Particularly

serious in this part of Russia were attacks of *Ustilago zeae* on maize, *Tilletia tritici* and *Puccinia graminis* on wheat, and *Phytolacter lycopersicum* on tomatoes. With regard to the latter disease, which in some cases destroyed the whole crop, the interesting observation was made that it was most severe on land poorly irrigated owing to shortage of water supply: this appears to be in contradiction to the general opinion that dampness of soil favours development of the disease. Watering experiments made at the Station in 1921 showed that while *Phytobacter lycopersicum* freely attacked tomato plants watered from above by sprinkling, it seldom appeared in plots watered by irrigation canals.

The Station publishes monthly leaflets dealing in a popular form with the most important pests of cultivated plants in the region, of which leaflets dealing with the following have reached us: *Oidium* (*Uncinula necator*) of the vine; anthracnose (*Colletotrichum oligochaetum*) of cucurbits; *Oidium* of cucumber, melon, watermelon, and vegetable marrow; apple and pear scab (*Fusicladium dendriticum* and *F. pirinum*); and *Orobanche aegyptiaca*. The last causes much damage to cucumber, melon, watermelon, and tomato, and also attacks cabbage and eggplants more rarely.

COTTON (A. D.). **Fungus diseases of crops 1920-1921.**—*Min. Agric. Misc. Publ.* 38, 104 pp., 1922.

The Ministry of Agriculture's Report on the occurrence of fungous, bacterial, and allied diseases of crops in England and Wales during 1920 and 1921 contains information invaluable both to the scientific worker and the grower.

The cold, wet summer of 1920 and the exceptionally hot and dry summer of 1921 provided excellent opportunities of gauging the influence of weather conditions on plant diseases, and also of judging to what extent one season's weather affects the prevalence and intensity of infection in the ensuing year. The total number of diseases recorded was 391, of which 150 occurred on fruit, 82 on vegetables, 40 on cereals, and 21 on potatoes.

Of an exhaustive and detailed report of this sort it is impossible to give a brief summary, but a few points of special interest may be mentioned.

In the wet spring and summer of 1920 late blight of potatoes (*Phytophthora infestans*) was very severe in the south and west of England and Wales, 50 per cent. of the tubers being infected in many cases. The disease was reported from the Scillies on 15th April, the earliest date on record, but it did not spread extensively in England until June. The varieties that suffered least were Kerr's Pink, President, and Evergood, the first named being immune, and the other two susceptible to wart disease.

In vivid contrast to 1920, late blight appeared phenomenally late in the dry season of 1921, the first record being on 25th July, and its intensity was also exceedingly slight. The interesting fact was discovered by Whitehead that in many cases the tubers of apparently healthy plants were infected, sometimes as severely in 1921 as in 1920. Trials by Lawrence are also reported which showed that by pulling out haulms when blight was first seen in July a clean crop

was secured, whereas when the haulms were pulled out later, 40 and 75 per cent. infection occurred on Edzell Blue and Arran Chief respectively. The advisability of adopting this treatment would of course depend on the date of the attack and other circumstances.

Wart disease (*Synchytrium endobioticum*) was very prevalent in the wet summer of 1920 and conspicuous by its absence in 1921. The number of new outbreaks in 1920 was the lowest for many years and that for 1921 lower still; several outbreaks, however, occurred in neighbourhoods hitherto free from the disease. A series of demonstrations was arranged in 1921 with the object of impressing upon growers the serious nature of the leaf roll disease and the value of healthy seed. The results showed that infected seed gave only from 36 to 75 per cent. of the yield from healthy seed. Both leaf roll and mosaic are more prevalent in the hot, dry parts of the country than at high altitudes and in the north. In 1921 the characteristic mottling caused by mosaic diseases was largely obscured as a result of the heat and drought. Corky scab (*Spongospora subterranea*), exceptionally bad in 1920 and almost absent in 1921, was successfully controlled at Leeds by Millard, who applied flowers of sulphur at the rate of 6 cwt. per acre, and thereby reduced the incidence of infection from 54 to 7·5 per cent. Scab (*Actinomyces scabies*) is a disease of hot, dry seasons, and was very prevalent in 1921. Millard has worked out a method of controlling this disease by the use of green manure. Pink rot (*Phytophthora erythroseptica*) was recorded for the first time in England in 1921.

Take all (*Ophiobolus graminis*) [*O. cariceti*] caused serious damage to wheat in five counties in 1920, and was present to a slight extent in all parts of the country. The characteristic brown mycelium was copiously developed at the base of the stem, at times associated with a *Fusarium*. Perithecia were obtained on specimens from Worcester in August.

A disease apparently identical with halo blight of oats (*Bacterium coronafaciens*), though the causal organism has not yet been isolated, was noticed in various localities, the damage sometimes being severe. Crown rust of oats (*Puccinia coronata*) [*P. loli*] occurred with unprecedented severity in 1920, whereas in 1921 the attack was almost negligible. Observations show clearly that this rust overwinters in England in the uredospore stage on autumn-sown oats. The aecidial stage of the rust on *Rhamnus catharticus* is not uncommon in infected districts.

Mosaic disease of mangolds was recorded for the first time in 1920–21. The disease occurred generally in the eastern and southern counties, and appeared in the crops about August, the incidence of infection ranging from 1 to 95 per cent. Sugar-beet was also slightly attacked by mosaic in 1921 in Nottinghamshire.

A bad attack of canker on frame and ridge cucumbers was reported from Sussex in 1918, since when it has been impossible to raise a normal crop in the infected localities. The causal fungus was formerly believed to be *Mycosphaerella citrullina*, but subsequent investigation by Brooks led to its identification as a form of *Diplodina lycopersici*.

There were no fresh cases of onion smut (*Urocystis cepulae*) either in 1920 or 1921. Trials of eleven varieties of leeks at

Wylam showed all to be susceptible, but decidedly less so than onions.

Apple mildew (*Podosphaera leucotricha*) caused severe damage in both years in spite of the marked climatic contrasts, and its prevalence appears to be increasing. In Great Britain the disease has hitherto been combated almost exclusively by pruning, but it may be necessary to resort to spraying if it gains further ground. Silver leaf (*Stereum purpureum*) became increasingly menacing during the period under review, extending its ravages to the apple; many hundreds of apple trees were killed by it in some of the eastern counties. The mode of infection and course of the disease in apples correspond in all respects with those of the same disease in plums. The prevention of unnecessary wounds, the tarring of exposed surfaces, and strict attention to general cleanliness are the only reliable control measures. *Myxosporium* canker (*M. corticolum*), well known in America, was recorded in England for the first time by Wiltshire in 1920.

A die-back of plums caused by *Diaporthe perniciosa* [see this *Review*, i, p. 63] was first observed in England by Miss D. M. Cayley in 1919, and has since been under investigation. The disease produces symptoms somewhat similar to those of *Cytospora*, and it is apparently widely distributed.

Weather charts of the temperature, rainfall, and sunshine for the six meteorological provinces of England are appended, from which it is possible to judge roughly the nature of the weather experienced in any week of the year.

Melhus (I. E.), Dietz (S. M.), & Willey (Florence). **Alternate hosts and biologic specialization of crown rust in America.**—*Iowa Agric. Exper. Stat. Res. Bull.* 72, pp. 211–236, 2 figs., 1922.

Crown rust (*Puccinia coronata*) [*P. lolii*] occurring on oats and *Calamagrostis canadensis* may have as an alternate host any of the American species of *Rhamnus* (*R. lanceolata*, *R. alnifolia*, *R. carolineana*, *R. californica*, and *R. purshiana*) together with the two imported species *R. cathartica* and *R. frangula*. The separation of *P. coronata* into two species, *P. coronata* and *P. coronifera*, by Klebahn, and of these two species into four series, by Eriksson, on the basis of the different species of *Rhamnus* used as alternate hosts, is therefore not justifiable in America. Not all species of *Rhamnus* are equally susceptible to the different biologic forms of the rust. The forms occurring on *Avena sativa*, *Calamagrostis canadensis*, and *Festuca elatior* prefer those species of *Rhamnus* most closely resembling *R. cathartica*. Crown rust on *A. sativa* produced normal accidia on *R. cathartica* and *R. lanceolata*, both of which may serve as important agents in the spread of the disease.

In the oat-growing sections of the United States, the four most common grass hosts of crown rust are *Avena sativa*, *Calamagrostis canadensis*, *Lolium perenne*, and *Holcus lanatus*. The form of the fungus on *A. sativa* is neither highly specialized nor limited in its host range. The results of inoculation experiments showed that species belonging to sixteen genera of grasses were susceptible to

it. The form on *Calamagrostis canadensis* was found to have susceptible hosts in fourteen genera. That on *Lolium* is capable of infecting thirteen genera; and eleven species in seven of these genera gave full infection with this form. It is believed to be possibly identical with that occurring on oats. On *Holcus*, on the other hand, the rust was very highly specialized, *Holcus* being the only grass fully infected amongst those tested with this biologic form.

The forms of crown rust on *Avena*, *Calamagrostis*, *Lolium*, and *Holcus* may, under certain conditions, use the same hosts, but manifest different degrees of infection. *A. sativa* was a common host, but with varying degrees of infection, for all the forms of crown rust studied.

DADE (H. A.). **'Collar crack': a new disease of Cocoa.**—*Journ. Gold Coast Agric. and Commer. Soc.*, i, 4, pp. 241-242, 1922.

Cacao plantations in Togoland were found to be attacked by an unfamiliar disease which has been named 'collar crack' on account of its very typical symptoms. Numerous radial cracks extend upwards for about 2 ft. from the collar or base of the trunk, causing injuries which generally result in the death of the tree. The cracks are marked externally by a narrow, frilly outgrowth of leathery, brown, fungous tissue. On felling the tree the cracks are found to extend to the middle of the trunk, and to be packed with compact plates of mycelium. The fructifications of the fungus, apparently a species of *Tricholoma*, appear on the collar, close to the ground, as a bunch of wet, soft, rusty-brown sporophores of the 'mushroom' type. Each sporophore is 2 to 3 in. in height and 1·5 to 2 in. across the cap.

The disease occurred on farms which were situated in hilly rain forest, and were suffering from the consequences of systematic neglect. The humidity of the atmosphere was intensified by a dense growth of low bush round the trees, which maintained the collars in a permanently soaking state.

It is recommended that infected trees should be dug out and burnt and the holes well limed. Thorough cultivation is considered to be the best preventive measure.

GRIFFEE (F.). **Breeding Oats resistant to stem rust.**—*Journ. of Heredity*, xiii, 4, pp. 187-190, 3 figs., 1922.

In the work of breeding cereals for rust resistance at the Minnesota Agricultural Experiment Station, the purity of the F_2 plants is determined on the basis of F_3 seedling tests made in the greenhouse before the date of sowing the field plots. The method is well illustrated by the results obtained in greenhouse tests used in breeding oats resistant to stem rust, *Puccinia graminis*. In 1921, 600 F_2 plants, which appeared resistant to rust under an artificially induced field epidemic, were harvested at University Farm. These plants were part of the progeny of the crosses of White Russian, a resistant variety, with Victory and Minota, both susceptible. As shown by Garber (*Journ. Amer. Soc. Agron.*, xiii, pp. 41-43, 1921), the F_1 generation in these crosses is as resistant as the White Russian parent, while in the F_2 generation segregation is in the

simple ratio of 3 resistant to 1 susceptible. A family of F_3 seedlings was grown from each of the 600 F_2 plants mentioned above, twenty-five kernels of each plant being reserved for the 1922 field planting and twenty-five or thirty of the remaining kernels planted in the greenhouse. The kernels from the same plant were planted together in a 4-inch pot. The seedlings were inoculated with stem rust, and notes were taken about a fortnight later on the type of infection obtained. Pots of White Russian and Victory seedlings were tested along with each series of hybrid material and the type of infection determined.

Under greenhouse conditions the inoculations resulted in a 4± type of infection [see this *Review*, ii, p. 158] on Victory, the highest obtained with any variety. With White Russian a 3± type was obtained, though under the most favourable artificial epidemic conditions in the field this variety never gives more than numerous small uredosori, and natural infection, even in years of severe rust epidemics, leaves it comparatively free from rust.

The number of F_3 families which bred true for resistance in the greenhouse approximated to expectations. In the cross White Russian × Victory, 82 F_3 families out of 229 tested bred true for rust resistance. This gives a ratio of 1·07 : 1·93, which is very close to the anticipated 1 : 2 ratio. In the cross Minota × White Russian and the reciprocal, 110 families out of 338 tested bred true for rust resistance, namely a ratio of 1·01 : 1·99.

Since it is possible in this manner to identify large numbers of homozygous resistant plants in the F_2 generation, the heterozygous F_2 plants may be eliminated from the field sowings.

Two methods of seedling inoculation were employed, namely ordinary inoculation and the brushing system. In the latter, which proved uniformly preferable, the seedlings are sprayed with water and brushed lightly with rusted seedlings. The incubation period is the same in each case.

WEBER (G. F.). **Septoria diseases of cereals. II. Septoria diseases of Wheat.**—*Phytopath.*, xii, 12, pp. 537–585, 4 pl., 16 figs., 1922.

In continuation of the author's studies on cereal diseases caused by species of *Septoria* [see this *Review*, ii, p. 159] two diseases of wheat, termed respectively 'glume blotch' and 'speckled leaf blotch' are described.

Glume blotch is caused by *Septoria nodorum* Berk. [*S. glumarum* Pass., *Macrophoma hennebergii* (Kuehn) Berl. & Vog.] and is known in Europe, the United States, and Australia. It is common especially in the southern and east-central States, where severe attacks may reduce the yield by 50 per cent.

All the aerial parts of the plant are subject to attack. On the glumes small, irregular, brownish spots appear, in which black pycnidia develop. Infection may spread, in favourable conditions, to the rachis and culm. On the leaves the spots are yellowish, then dry up and become lighter in colour, a few scattered pycnidia appearing on both surfaces. In severe attacks the leaf may be killed.

The morphology and cultural characters of the fungus are described in great detail. Conidia were produced laterally, usually

at the septa of germinating pycnospores, on oatmeal agar, and were oblong, hyaline, 3-septate, and 18 to 32 by 2 to 4 μ. Perithecia were found in the field, and compared with other collections of an ascigerous stage found associated with *S. nodorum*, but the genetic connexion of the pycnidial and perithecial stages was not established by cultures. The perithecia probably belonged to the genus *Leptosphaeria*. The optimum temperature for growth in culture was 20° to 24° C.

The fungus proved capable of infecting all the species of *Triticum* tested, and also rye and *Poa pratensis*. The pycnospores remain viable in the pycnidia through the winter with little loss of germinating power. More than 30 per cent. germinated after eighteen months in the open. They are killed very easily by drying and by the action of direct sunlight. In Wisconsin infection of the leaves may be found from April and of the glumes from June. Infection occurs by direct penetration of the cuticle, the hyphae passing between the epidermal cells and remaining confined to the intercellular spaces of the parenchyma. Spots first appear in six or seven days and mature pycnidia, which always develop in the sub-stomatal chamber, in twelve to sixteen days. Severely infected plants are stunted and the ears empty or with only a few shrivelled grains. Infection at the nodes appears to have a marked stunting effect.

In the second disease, as the name 'speckled leaf blotch' indicates, the spots are characteristically speckled from the presence of dark brown or black pycnidia in great numbers in the light-coloured, dead tissues. These belong to the fungus *Septoria tritici* Desm., which the author considers to be quite distinct from *S. graminearum* Desm. No ascigerous stage was found. The fungus is widely distributed in Europe, Asia, Australia, and America; in Wisconsin it may be found in almost every field of winter wheat. Where infection is severe many seedlings are killed and the new tillers formed during the winter and spring are also often killed. Later in the season the losses from attacks on older parts of the plant are negligible.

On the seedlings circular or oval spots develop on the leaves, gradually spreading so as to involve the whole surface. The other parts of the plant are not attacked. Pycnidia are found in quantities on the spots or covering the entire leaf surface. On older plants the spread of the disease is usually slight and few new spots appear after the flowering stage.

The fungus is variable. In cultures the growth may be hyaline or dark, while the spores vary in size on the host plant according to the period of the year, those formed in the winter being considerably larger than the summer ones. Conidia are numerous in culture and were also found on artificially inoculated plants. They resemble the pycnospores closely. The optimum temperature for growth is 22° C. to 26° C.

S. tritici infects the leaves of the same hosts as *S. nodorum*. All the other plants tested were immune. It overwinters on winter wheat and in the pycnidial stage, the pycnospores remaining viable in the pycnidia for over a year. The incubation period is about six or seven days for the first spotting, and eleven to fifteen days

for the development of mature pycnidia. The method of infection and pathological histology are much the same as in *S. nidorum*. No haustoria were found.

BRANSTETTER (B. B.). **Fungi internal to Missouri seed Corn of 1921.**—*Journ. Amer. Soc. Agron.*, xiv, 9, pp. 354–357, 1922.

Samples of 1921 seed maize from different parts of Missouri were examined for the presence of internal fungi. After surface sterilization in 1 in 1,000 mercuric chloride solution and thorough washing with sterile water, the tips of the kernels were planted in Petri dishes on potato-dextrose agar and incubated for twenty to thirty days at about 25° C. The ears from which the kernels were taken were arranged in two groups according to the severity of the disease symptoms. The first group (badly diseased ears) contained nearly twice as many kernels infected with *Diplodia zeae* and *Fusarium moniliforme* as the second group (apparently disease-free ears). The latter group, however, contained many more kernels infected with *Cephalosporium sacchari*. Only one culture of *Gibberella saubinetii* was obtained from more than 1,600 plantings.

Of the 192 seed ears examined, only nineteen appeared completely clean and healthy. Nine of these ears were disease-free when tested in culture, and only four showed as much as 50 per cent. infection. On the other hand, the ears selected for their diseased appearance generally showed 100 per cent. infection of the grain.

MELHUS (I. E.) & DURRELL (L. W.). **Dry rot of Corn.**—*Iowa Agric. Exper. Stat. Circ.* 78, 3 pp., 8 figs., 1922.

Germination tests of thousands of samples of seed maize on Iowa farms indicate that a large proportion is unfit for sowing, chiefly owing to the ravages of the dry rot fungus, *Diplodia zeae*, the life-history of which is described in this paper. In the autumn of 1921 mouldy maize was common throughout Iowa. High temperature and rainfall, which favour the development of the fungus, were combined in the central and eastern parts, where the damage from dry rot was estimated at 5 to 20 per cent.

The fungus attacks all parts of the plant. Infected roots and stem nodes exhibit a dark brown discoloration; the shanks of the ears break readily, and in some cases the fungus works up into the butt. It may also attack the tip, entering from the silk. In other cases the husks catch and hold the spores and infection results. The mycelium grows freely in the tissues of the cob, causing a brown discoloration of affected parts. Infected ears are of little use for seed, and should be kept for fodder.

There is no consistent evidence that the mycelium habitually travels from the soil to the ears inside the stalk. Recent studies showed that 39 per cent. of the infected ears were borne on healthy stalks. The fungus is only known to attack field and sweet maize. The minimum temperature for growth is 40° F., the maximum 90° F., and the optimum 80° to 86° F. When the maize is dried the fungus lies dormant, but will grow again when moisture is supplied.

The modified rag doll germinator gives very good results in tests

for germinating strength, but a glass-topped sand-box germinator, though somewhat more expensive, is superior, being free from the limitations incidental to the former method. The practical application of both these methods of determining the degree of infection is described in detail.

ZADE (A.). **Experimentelle Untersuchungen über die Infektion des Hafers durch den Haferflugbrand (Ustilago avenae Jens.).** [Experimental investigations of the infection of Oats by loose smut (*Ustilago avenae* Jens.).]—*Fühlings landw. Zeit.*, lxxi. 21–22, pp. 393–406, 4 figs., 1922.

The author believes that infection of oat seedlings with *Ustilago avenae* rarely occurs from spores of the fungus that have adhered to the outside of the glumes. His attempts to secure infection by heavy application of spores on the exterior of the glumes did not give an appreciable amount of smut. Further experiments, in which the spores were applied after the glumes had been removed, gave better results; it is evident that spores that have penetrated between the glumes can cause infection, though the degree of infection was not sufficient to account for the frequency of epidemic attacks of the disease.

Tests made by applying spores to the ears during flowering revealed the interesting fact that almost all the spores that fell on the stigma began to germinate in 15 to 20 hours in mild, damp weather. The promycelia formed tended to be unusually long, but were otherwise normal and bore budding sporidia. The latter gave rise to hyphae which came in contact with the inner wall of the glumes and formed a mycelium in the peripheral parenchyma of the latter. There was no evidence of flower infection such as is known in *Ustilago tritici*, the embryo remaining free from infection and only the glumes being invaded. The author believes that this mycelium and the secondary sporidia that are borne on the hyphae on the inner surface of the glumes form the most important source of infection in oat smut. For effective control by seed steeping it is essential that the fungicide should penetrate within the glumes and prevent infection of the young seedling from the fungus in this situation.

MOLE (D. C.). **A new Orange pest in Arizona.**—*Monthly Bull. Dept. Agric. California*, xi, 8–9, pp. 628–633, 1922.

A recent examination of the Washington and Australia navel oranges in the Salt River Valley, where the loss from dropping of the fruit was stated to be above the normal, revealed the presence of small, pink, lepidopterous larvae, associated with black rot caused by the fungus *Alternaria citri*. The work of the larvae in the oranges somewhat resembled that of the codling moth (*Carpocapsa pomonella*) in the apple. The life-history and habits of the insect (probably *Myelois* sp.) are described. It is not yet known whether it or the fungus is the primary cause of the damage, which is serious. Pending the results of further investigations, the Arizona Commission of Agriculture has prohibited the movement of navel oranges from that State to California.

SIMMONDS (H. W.). **Bud-rot disease of Coco-nuts in Fiji.**—*Agric. Circ.* [*Dept. of Agric. Fiji*], iii, 3, pp. 39–40, 1922.

During the past eighteen months serious damage to coco-nut palms in the Fiji Islands has been caused by bud rot. The disease is almost entirely restricted to the wetter portions of the islands, being rare on the coast and abundant along the inland foothills. Trees from five to fifteen years of age are more susceptible to the disease than older ones, though in one area of excessive rainfall (Vanualevu) numerous trees of twenty to thirty-five years old were attacked.

The first symptom is generally the wilting and falling over of the central unopened leaf of the tree, leaving an outer ring of leaves and nuts which are gradually shed until only the bare pole is left. An irregular, greenish-brown or yellow spot usually occurs at the base of about the eighth leaf or flower spathe from the central core, and a patch of decay extends from this to the central portion of the stem, which is in a rotten and foul-smelling condition. Indications were observed that infection starts at the leaf bases and penetrates inwards, not through the outer, overlying leaf sheaths. On the infected material submitted to the Imperial Bureau of Mycology, a fungus agreeing in its mycelial characters with the parasitic species of *Phytophthora* described as the cause of coco-nut bud rot in other countries was found ramifying between the cells. Exact identification was impossible in the absence of fructifications.

It is suggested that the spread of the disease is likely to be assisted by the hurricanes which are frequent in Fiji. The spraying of young trees, especially at the leaf bases, with a strong Bordeaux mixture is recommended as a preventive. Once the tree is actually attacked, however, it should be cut out and the head burnt immediately.

ELLIOTT (J. A.). **A new Ascochyta disease of Cotton.**—*Arkansas Agric. Exper. Stat. Bull.* 178, 18 pp., 4 pl., 1 fig., 1922.

The disease previously attributed to *Phoma* in a preliminary paper which has already been noticed [see this *Review*, i, p. 59], has now been found to be due to *Ascochyta gossypii* Syd., hitherto only recorded from Kashmir, where it was collected in 1908.

The blight attacks all the aerial parts of the plant except the blossoms, and is capable of infecting leaves, stems, or bolls without any apparent previous wounding of the tissues. Under very humid conditions the fungus invades the leaf tissues very rapidly, advancing 1 cm. or more in twenty-four hours, and producing greyish, water soaked spots which, under slight pressure, break down into a pulpy mass resembling vegetables destroyed by bacterial soft rot. In drier weather the outer edge of the spot is reddish-brown, the cortex being of a lighter colour.

The spots on the bolls and stems are generally darker than on the leaves. Stem infections were much the most conspicuous during the 1920 epidemic. The liver-coloured spots occurred mainly at the bases of the leaf petioles, and seemed to centre round the stipules. Longitudinal extension rapidly followed, the leaves dying when the base of the petiole became involved. The girdling

of the stem resulted in desiccation and death of the parts above the lesion. As the spots enlarged the centres disintegrated and fell out, leaving only the bast fibres of the bark crossing the lesions.

The spots on the bolls are usually similar to those on the stem, except for the darker centres of the former. Shredding of the diseased tissues is also less marked on the bolls. A dark green, water soaked area occurs when there is a rapid advance of the fungus, otherwise the border of the spots is dark brown. Drought may check the external advance of the spot while the internal attack continues, sometimes causing the sudden collapse of the bolls. Mature lint is easily destroyed and, in half-open bolls, may be full of the grey fruiting bodies of the fungus. In 1920 there were no natural infections of the bolls, but artificial infections were readily obtained by needle pricks. The resulting spots were found to be identical with those occurring naturally on diseased cotton plants collected in Arkansas in 1915 and preserved in the pathological laboratory.

An extensive series of inoculation experiments was carried out under varying conditions, the first spots appearing in from one and a half to five days, and pycnidia about three days later. In the field, leaf infections were successful only in a very humid atmosphere. Natural infections took place during rainy weather in October on the plants which had previously been inoculated, and on those adjacent to them, the remainder of the crop not being affected.

During the winter the fungus was found to develop saprophytically on the infected plants, the pycnidia and their spores being morphologically similar to those of the parasitic fungus. In the following spring spores from these saprophytic colonies were capable of infecting healthy seedlings on inoculation. Later on in the summer of 1921 the disease became epidemic in the experimental plot, and vigorous plants succumbed to the attack almost as rapidly as pear twigs suffering from fireblight.

Examination of the tissues of the diseased plants showed that the host cells gave normal staining reactions up to the limit of the advance of the mycelium, while the middle lamellae were also apparently unchanged. The main advance of the fungus was intercellular, but the cells were subsequently invaded and destroyed by the hyphae, and in young tissues the tracheae and wood cells were also killed. The action of the fungus appeared to be identical on the tissues of all parts of the plant. The older parts of the lesions revealed very little mycelium, and nothing in the nature of a stroma was formed. The mycelium was apparently most abundant near the outer limit of advance through the host tissues. Closely behind the outer limit the host tissues were collapsed and pycnidia occurred in various stages of development. These results indicate a somewhat narrow zone of parasitism, and may explain the dependence of the fungus upon weather conditions.

The disease apparently occurs only in central and west central Arkansas. As the fungus can overwinter on dead stalks in the field, the growth of some other crop for at least one season is recommended on infected land. It is improbable that the disease is carried over from year to year on the seed, as in the case of anthracnose [*Glomerella gossypii*].

Brown (J. G.). **Black-arm of Cotton: a successful method of control.**—*Arizona Agric. Exper. Stat. Timely Hints for Farmers* 142, 8 pp., 4 figs., 1922.

Black-arm of cotton (*Bacterium malvacearum*) is the cause of extensive losses to growers, the reduction in yield from the disease in the United States being estimated in 1920 at 213,000 bales. Affected plants may be recognized by the water soaked areas on the stems and leaves of seedlings; in older plants the bolls are also attacked. The spots or lesions, which darken with age, exude a bacterial slime and the growth of the plant is checked. On the stems the spots are generally longitudinal, and their appearance has given rise to the term 'black-arm'; on the leaves they are triangular or quadrilateral, hence the name 'angular leaf spot' by which the disease is also known. On the bolls the spots are usually circular and depressed at first, but later the shape is irregular.

The bacterium is carried on the seed, and its development is favoured by warm, moist weather. The Egyptian and Sea Island varieties are the most susceptible, while the upland types are comparatively resistant.

The disease may be controlled by immersion of the seed in sulphuric acid for fifteen minutes. For each 100 lb. of seed, approximately 3 galls. of concentrated sulphuric acid, chemically pure, specific gravity 1·84, are required. This treatment has proved extremely successful under Arizona conditions, one treated, 14-acre field in the Salt River Valley being practically free from black-arm, while another field on the same farm was so badly infected that 238 diseased plants were counted in one row, 35 rods in length. The treatment also accelerates germination, and its general adoption is strongly recommended.

Brandes (E. W.). **Onderzoek op grooten afstand betreffende de verwelkingsziekte der Bananen.** [An investigation at a distance of the wilt disease of Bananas.]—*Teysmannia*, xxxiii. 7-8, pp. 294–297, 1922.

Referring to Gäumann's belief that the vascular or Panama disease of bananas is caused by a bacterium, identical with or allied to his *Pseudomonas musae* [see this *Review*, i, p. 225], the author maintains the view that *Fusarium cubense* is the primary agent. He considers it evident from the published account of the Java disease that the author is not familiar with the much more serious wilt of the West Indies, and that the attempted comparisons in his paper are based on insufficient study of the publications dealing with Panama disease. Various statements regarding the latter, as for instance that Brandes did not mention the existence of bacteria in the diseased tissues, that he did not succeed in inoculating the underground parts of the banana with *F. cubense*, that he used diseased bananas for his experiments, and so on, are based on a complete misunderstanding, as may be seen by reference to the original paper in *Phytopathology* (ix, p. 339, 1919). Gäumann's isolation of a weak bacterial parasite from wilted bananas in Java is not in any way evidence that a bacterium is the primary cause of the Panama disease.

Replying to the above criticisms (pp. 297–300), Gäumann refers

to his successful inoculations of the rhizome, aerial stem, and leaves of bananas with *Ps. musae*, and contrasts them with his own and Brandes's (*Ann. Rep. Mich. Acad. Science*, 1918, p. 273) failure to secure the same results by direct inoculation of the above ground parts with *Fusarium*. If the latter is really the primary cause of Panama disease, why have all investigators failed in their attempts at direct inoculation of healthy plants with the organism? It is suggested that *F. cubense* is unable to develop in healthy tissues and appears only when the latter are already discoloured by the action of the bacterium. It may, therefore, be regarded as a secondary organism, the strongly toxic properties of which produce the typical symptoms of the later stages of the disease.

FERDINANDSEN (C.). **Ueber einen Angriff von Krebs (Fusarium willkommii Lindau) an Apfel- und Birnfrüchten.** [An attack of canker (*Fusarium willkommii* Lindau) on Apple and Pear fruits.]—*Angew. Botan.*, iv, 4, pp. 173–184, 3 pl., 1922.

In the autumn of 1919 fruits of pears in Denmark were attacked by an unusual disease characterized by depressed, sharply defined, brown spots originating on scab [*Venturia pirina*] wounds, and spreading thence over the greater part of the fruits. In the spots were numerous spore layers covered with hairs, white at first, afterwards bare and greyish, and turning brownish when dried. Microscopical examination showed that the fungus was indistinguishable from *Fusarium willkommii*, the conidial stage of *Nectria galligena*. In 1920 the same disease was found on apples from two different localities.

Inoculation experiments with conidia from naturally infected pears, and also from pure cultures, produced the typical depressed and rather dry, brown and soft rot on pear and apple fruits of several varieties. In all cases the skin of the fruit was more or less injured prior to inoculation. Further inoculations with pure cultures of the fungus from pear and apple fruits were carried out on branches, the fungus from each host being tested on both apple and pear. They produced typical canker wounds bearing the fructifications of *F. willkommii*. The inoculations were made through deep cuts on the branches. The fungus was re-isolated from the artificially infected pear branches, and inoculated into pear and apple fruits, on which it again produced the typical soft rot. Re-isolated from infected apple branches, the fungus produced soft rot on pears, but the apples used in a similar experiment were destroyed by *Penicillium glaucum*.

A further series of experiments with *F. willkommii* isolated from natural canker wounds on an apple tree, showed that the fungus was able to produce a decay, corresponding to the soft rot here described, on apple and pear fruits.

COLBY (A. S.). **Limiting factors in Illinois Raspberry culture.**—*Trans. Illinois State Hort. Soc.*, lvi, pp. 337–341, 1922.

Raspberry culture in Illinois has been declining in importance for a number of years, partly as a result of disease. Crown gall [*Bacterium tumefaciens*] is rapidly suppressing the cultivation of both black and red raspberries [*Rubus occidentalis* and *R. idaeus*].

The disease cannot be controlled by spraying, and infected nursery stock is responsible for disseminating it widely. Nursery inspection is fundamentally unreliable, as the disease does not necessarily appear externally during the first season of attack. Authracnose [*Glocosporium venetum*], though widespread and destructive, can be satisfactorily checked by two applications of lime-sulphur, one of dormant strength when the leaves have expanded about one-quarter of an inch, and one of summer strength when the shoots are 6 to 8 inches in height. In a series of experiments at Peoria in 1922 the 'Rex' brand of lime-sulphur was used (1 in 8 winter and 1 in 40 summer strength). The mixture was applied very thoroughly with a short spray rod (Myers hand pump) and Vermorel nozzle. Owing to the peculiarities of its bark, the blackcap [*R. occidentalis*] is difficult to spray, and the addition of a spreader, such as casein, is recommended.

Eastern blue stem [see this *Review*, ii, p. 128] was observed for the first time in Illinois during 1922. The field where the disease was noticed was planted with Michigan nursery stock purchased some years ago. Judging by the severity of the disease in Michigan, a serious situation is likely to arise in Illinois, especially as infection cannot be held in check by spraying. The berries produced are small and of inferior quality, and 10 per cent. more fruit is required to fill a quart box from a diseased than from a healthy bush. In order to prevent the further spread of the disease a system of drastic roguing must be followed. The Michigan authorities are making every effort to stamp out the disease in that State.

ROBERTS (J. W.) & PIERCE (L.). **The bacterial spot of Peach.**—*Trans. Illinois State Hort. Soc.*, lvi, pp. 78-87, 1922.

Bacterial spot of peach [*Pseudomonas pruni*], the symptoms of which are described, occurs in most of the peach-growing areas of the United States, being especially severe in the southern districts. Almost all varieties are attacked, the most susceptible being J. H. Hale, Elberta, Carman, Champion, and Waddell. The control of the disease presents considerable difficulties owing to the liability of the trees to spray injury. Bordeaux mixture suppresses the disease, but damages the foliage more severely than the bacillus itself. Lime-sulphur compounds do not give control. The results of the authors' experiments in Arkansas showed that losses from the disease can best be reduced by careful attention to pruning and cultivation, and by fertilization with nitrate of soda (2 or 3 lb. per tree). Treatment with bone meal and acid phosphate, though not nearly so satisfactory as the nitrate applications, somewhat lessened the amount of infection.

BRITTON (W. E.), ZAPPE (M. P.), & STODDARD (E. M.). **Experiments in dusting versus spraying on Apples and Peaches in Connecticut in 1921.**—*Conn. Agric. Exper. Stat. Bull.* 235, 17 pp., 6 pl., 3 figs., 1922.

Dusting experiments in comparison with spraying were conducted in Connecticut in 1921 in four apple orchards and two peach orchards. In each case two treatments were given after blossoming on apples, and three on peaches.

The dusts used in the apple orchards were the sulphur-lead, sulphur-lead-nicotine, and Sanders' dusts, while the liquid spray used for comparison in all apple orchards contained liquid lime-sulphur, lead arsenate, and nicotine sulphate. In one apple orchard comparative tests were made between dry lime-sulphur and liquid lime-sulphur, B.T.S., and Bordeaux mixture, with lead arsenate added to each. All the tests are described in considerable detail. In nearly all cases the best results were obtained from the sprayed plots, and the sprays were more effective than the dusts in controlling fungous diseases. Both sprays and dusts adequately suppressed codling moth and other chewing insects; neither controlled curculio. In the sprayed orchard, dry lime-sulphur gave a larger percentage of good fruit than liquid lime-sulphur, B.T.S., or Bordeaux mixture. During 1921 the principal fungous diseases of apples in the orchards under observation were scab [*Venturia inaequalis*], black rot [*Physalospora cydoniae*], fruit speck, and sooty blotch [*Leptothyrium pomi*].

On peaches the only spray used was atomic sulphur, and the dusts were sulphur and sulphur-lime-lead arsenate. In all the peach orchards the dusted plots gave slightly better fruit than the sprayed ones. Peach scab [*Cladosporium carpophilum*] and brown rot [*Sclerotinia fructigena*] were controlled by both dusting and spraying. Dusting is more costly than spraying both in peach and apple orchards.

HÖSTERMANN. **Versuche über die Eignung neuer Pflanzenschutzmittel zur Bekämpfung des Apfelmehltaues (Podosphaera leucotricha).** [Experiments on the efficacy of new plant protection methods for the control of Apple mildew (*Podosphaera leucotricha*).]—*Ber. höh. Gärtnerlehranst. Berlin-Dahlem, 1920-21*, pp. 96–97, 1922.

During 1920–21 apple mildew occurred with unprecedented severity in Germany. Dormant spraying was carried out with various fungicides early in March in an orchard of ten year old espaliers, Landsberger Renettes grafted on Doucins. When the buds opened the sprayed trees were found to be quite as badly infected as the untreated controls. These negative results were probably due to the inability of the spray to penetrate the buds and thus reach the overwintering mycelium, rather than to any lack of fungicidal efficiency in the large number of mixtures used.

The summer treatment, which also comprised the principal up-to-date fungicides, was applied in two separate series, on pruned and unpruned trees. The effect on the latter was practically nil, but a certain improvement was noticeable in the former, especially after the use of solbar, colloidal sulphur (now known as 'cosan'), and lime-sulphur.

In a spraying experiment conducted in the Dahlem Horticultural College orchard in the summer of 1920, colloidal sulphur (0·05 per cent.), 'Bordola' sulphur (0·05 per cent.), and 'Prae' sulphur (0·05 per cent.) gave satisfactory results, while uspulun not only failed to control the disease, but also burnt the foliage.

The author concludes from the above results that winter spraying against apple mildew is merely a useless expense, and that summer

treatment must be preceded by thorough pruning. The use of resistant varieties appears to be the only permanent means of control.

SWINGLE (D. B.) & MORRIS (H. E.). **The brown bark spot of fruit trees.**—*Montana Agric. Exper. Stat. Bull.* 146, 22 pp., 6 figs., 1921. [Received 1923.]

The disease termed brown bark spot causes severe damage to apple and pear trees, and has also been observed on peach, plum, prune, and cherry, though it is seldom serious on stone fruits. It has been known throughout western Montana since 1910, and also occurs in Idaho, Oregon, and Washington. Recently specimens of what is apparently the same disease have been received from Japan.

The chief symptoms are the death of the buds on certain branches, the appearance of elevated brown spots on the bark, which is killed, and ultimately the death of the aerial parts of the tree. When the buds of the apple are swelling and opening, a certain number are found small, shrivelled, and dead. They may be confined to a single shoot or extend over the whole tree. Those that die without opening have a conspicuous, dark brown streak, running down through the centre to the base. Frequently the bark around the bud dies and becomes sunken. The fibro-vascular bundles that extend through the bark from the leaf scars are blackened. A week or two later small, raised, pimple-like spots, about $\frac{1}{8}$ inch in diameter, appear on the bark of the youngest shoots. These are at first of the same colour as the normal bark, but the centre soon assumes a green, water soaked appearance and then turns brown. The bark on the smaller diseased twigs shrivels and dies, but that on larger branches (above $\frac{1}{2}$ or $\frac{3}{4}$ in. in diameter) may remain alive and green for several weeks, though growth is checked.

Some weeks after these early symptoms, the brown spots typical of the disease develop on the larger branches and trunk up to 5 in. in diameter. The spots are nearly circular and from $\frac{1}{2}$ to 3 inches across. They are elevated ($\frac{1}{16}$ to $\frac{1}{8}$ inch in height), rather spongy in texture, reddish-brown at the margin and mottled pale green and brown inside. Later in the season they often crack away from the surrounding bark. Above the spotted areas the branches may be either entirely leafless or remain for some time apparently normal and fully provided with leaves. Ultimately the bark dies back progressively from the tips of the branches. Red-brown streaks can usually be found in the cambium and inner bark long before any external discoloration is visible. Sometimes young trees are killed to within a few inches of the ground in a single season. In less severe cases only a few limbs may be affected in the first season, and partial recovery occurs occasionally. Complete recovery is extremely rare. The bark of the root system is quite free from any symptoms of the disease, and the roots are the last part of the tree to die.

On pear trees the symptoms of brown bark spot differ in some respects from those on the apple. After the death of the buds both small and large spots appear on the bark, the colour of the large ones being a very dark grey. The inner bark turns almost black,

and the cambium of limbs ½ to 2 inches in diameter is often blackened in streaks 1 to 3 feet long. The discoloration extends outward half way through the bark as a mottling, the black mingling with the normal whitish colour of the tissues.

In stone fruits the symptoms are generally similar to those described above, but much less conspicuous owing to the fact that the normal colour of the bark is almost identical with that of the spots.

Repeated attempts to isolate a causal organism from the diseased tissues have given negative results, and the inoculation of healthy trees with diseased bark also completely failed to reproduce the symptoms. This evidence, though not absolutely conclusive, strongly suggests the absence of any infective agent, and the fact that affected trees are usually either isolated or in small groups favours the theory that the disease is due to some fault in the chemical composition of the soil.

It is difficult to suggest intelligent control measures without more definite knowledge of the cause of the disease, but the authors are convinced that, at any rate, the factor of contagion can be dismissed from consideration. On the hypothesis that the disease may be due to infertility of the soil in respect of certain requisites of plant food, possibly nitrogen and phosphorus, the application of these elements is recommended. Top-working by means of grafting and budding gave good results in certain cases. The disease occurs both in irrigated and non-irrigated land, so that soil moisture can be ruled out as a determining factor, and the same may be said of climatic conditions. The chemical composition of the soil is at present being investigated by the Chemistry Department of the Experiment Station.

HÖSTERMANN. **Versuche zur Bekämpfung der Kohlhernie (Plasmodiophora brassicae).** [Experiments in the control of club root of Cabbage (*Plasmodiophora brassicae*).]—*Ber. höh. Gärtnerlehranst. Berlin-Dahlem, 1920–21*, pp. 100–103, 1922.

Experiments in controlling *Plasmodiophora brassicae* by means of uspulun were carried out in the summer seasons of 1920 and 1921. In the 1920 trials uspulun was applied to the infected soil of the frames in the form of powder and its effect tested by growing the following plants in the treated soil: mustard (*Sinapis alba*), head cabbage, Brussels sprouts, kale, kohlrabi, red cabbage, cauliflower, and stocks [*Matthiola*]. Excellent results were obtained by the application of 0·25, 0·5, 1, and 1·25 gm. of uspulun per litre of soil (each frame containing 16 l. of soil), barely a trace of infection being found in the first two cases and none at all in the others. Quite satisfactory results also followed the application of only 0·1 gm. uspulun per litre of soil, the percentage of healthy plants being very high as compared with the untreated controls, all of which, except the stocks, were severely infected.

In 1921 uspulun was applied to the soil in the form of a liquid spray (1½ l. of a 0·25 per cent. solution per 8 l. of soil), the test plants comprising red cabbage, kohlrabi, head cabbage, and mustard. The results were not nearly so good as in the previous year, probably because the uspulun salts were retained in the upper layers

of the soil. In the case of mustard, the fungus appears to act as a stimulant to growth, which is further promoted by the uspulun treatments. The growth and seed production of diseased mustard plants, especially when treated with uspulun, greatly exceeded those of healthy ones.

Mustard was the most susceptible of the plants tested and stocks the least. Head and red cabbage were the most resistant cabbage varieties. Further tests in 1921 showed that when grown in heavily infested, untreated soil the percentage of diseased plants of wallflower was 85, of stocks nil, and of shepherd's purse (*Capsella bursa-pastoris*) 62. The latter should therefore be eradicated from the fields during the rotation.

JUNGE (E.). **Praktische Massnahmen zur Bekämpfung tierischer und pflanzlicher Feinde.** [Practical measures for the control of animal and vegetable enemies.]—*Ber. höh. staatl. Lehranst. für Wein-, Obst-, und Gartenbau zu Geisenheim-am-Rhein 1920–21*, pp. 28–29, 1922.

Fungous diseases were on the whole held in check in 1921 by the protracted heat and drought. Apple mildew [*Podosphaera leucotricha*], however, was extremely severe, scarcely a single variety being free from damage. The excision of affected shoots during the winter proved useless, and the application of 10 per cent. carbolineum in the middle of March also had no effect.

At the end of May experiments in the control of apple mildew with solbar were begun. The leaves were then fully developed and severely infected. A preliminary 1 per cent. application was followed by spraying with a 2 per cent. mixture at fortnightly intervals. Though not completely suppressed, the development of the fungus was satisfactorily checked, and absolute control would probably be ensured by starting the applications of solbar while the trees are still dormant.

Both solbar and potassium sulphide gave good results in the control of American gooseberry mildew [*Sphaerotheca mors-uvae*].

HÖSTERMANN. **Zur Frage der Ueberwinterung des Apfelmehltaues. (Podosphaera leucotricha).** [The question of the overwintering of Apple mildew (*Podosphaera leucotricha*).]—*Ber. höh. Gärtnerlehranst. Berlin-Dahlem, 1920–21*, pp. 97–98, 1922.

In January, 1922, shoots of espalier apple trees which had suffered severely from mildew in the preceding summer were gathered, immersed in warm water (35° C.), and then immediately sprayed with 'cellocresol' 2·5 per cent. (Saccharinfabrik, Magdeburg), solbar 5 per cent. (Bayer, Leverkusen), 'Nosperal' 2 per cent. (Meister, Lucius & Brüning Dyeworks, Höchst-am-Main), a new [unnamed] organic copper preparation 2 per cent., and 'Dendrin' 2·5 per cent. (Avenarius). The shoots were then placed in a greenhouse where re-infection with apple mildew was extremely improbable. Under these conditions the buds opened and most of them were attacked by mildew, irrespective of the fungicides used.

This confirms the results of previous tests [see above p. 220], which indicate that winter spraying is of no avail, the mycelium

being situated in the interior of the bud, and therefore out of reach of the fungicide.

GEHRING (A.) & BROTHUHN (G.). **Ueber die Wirkung verschiedener Beizmittel auf Rüben. I. Beizversuche mit Germisan.** [The effect of various disinfectants on Beets. I. Disinfection experiments with germisan.]—*Fühlings landw. Zeit.*, lxxi, 15–16, pp. 281–289, 1922.

The results of repeated tests in the disinfection of beet seed against root rot (*Pythium de Baryanum* and *Phoma betae*) carried on at the Brunswick Agricultural Experiment Station, showed that in sandy soil, steeping in germisan considerably delayed germination, whereas in clay soil it accelerated germination at a strength of 0·1 per cent., and did not appreciably delay it at any concentration up to 0·5 per cent. Root rot was very satisfactorily controlled by germisan (0·25 to 1 per cent.) and uspulun (0·25 per cent.). 'Segetan' also gave good results, especially in respect of increased germination; it did not control root rot quite as completely as the other two disinfectants.

OBERSTEIN. **Saatbeizapparat-Ausstellung.** [Exhibition of seed disinfection apparatus.]—*Angew. Botan.*, iv, 4, pp. 185–190, 2 pl., 1922.

At a special exhibition of seed disinfection apparatus at Breslau in May 1922, several interesting machines were shown. It is pointed out that a good apparatus must absolutely free the grain from unbroken bunt balls, which are a common source of reinfection of wheat with *Tilletia tritici*. It must also remove the air from the hairs and furrows of wheat and from between the glumes of oats. Not only must light grain be separated (particularly necessary in seed treatment against *Fusarium* and *Helminthosporium* diseases), but also the seeds of certain weeds that are so light as to be difficult to remove by sifting. Finally it must be easily adjusted for the prescribed periods of treatment and be easy to clean.

Two chief types of construction appear to have been exhibited. In one the grain is fed in and removed either by a continuous screw or a scoop; in the other it is placed in an inner, tipping, vessel which can be dipped into and removed from the outer vessel filled with the steep.

In all cases the best results in removing unbroken bunt balls, light grain, and weed seeds are got when the container is first filled to overflowing with the liquid and the grain then fed into it, a large surface being provided for the overflow which carries off the light seed and débris. The grain must on no account be poured in before the container is filled, as once the bunt balls have been completely immersed they do not rise so readily to the surface.

For removing air the continuous screw apparatus provided sufficient movement in some machines, while in others the grain is stirred vigorously with a horizontal bladed paddle or a stream of compressed air blown through it.

In timing the treatment the screw principle is the easier, but gives less accurate timing and less thorough work than the double

container, and this advantage of the latter may be considered to balance the extra trouble in working it.

No details of the construction of the machines are given.

RUTH (W. A.) & KELLY (W. W.). **Recent advances in spraying.**—*Trans. Illinois State Hort. Soc.*, lvi, pp. 90–103, 3 figs., 1922.

Amongst the improvements in spraying practice that the authors are convinced, both from an examination of the work of other investigators and their own extensive laboratory experiments, are most urgently needed are the use of heavier applications of the spray fluid and the finding of a substitute for lime-sulphur. The latter is stated to be proving injurious in many cases.

The use of spreaders has already done much to overcome difficulties in application due to lack of adhesion of the spray to the surface sprayed. By the addition of casein-lime to lime-sulphur a perfect covering for peaches is formed, and this spreader also increases the adhesiveness of Bordeaux mixture on plums. More spray also adheres to apple shoots dipped into winter strength lime-sulphur when casein-lime is added. It was found that immersion of peach shoots for one minute in the lime-sulphur and casein-lime solution ensured greater adhesiveness than when the immersion lasted about a second. Similar time effects, as well as increased adhesiveness from the use of casein-lime, were observed when sections of radish leaves were immersed in Bordeaux mixture. The results of orchard experiments on Ben Davis, Winesap, and Grimes apples showed that the addition of casein-lime to the lime-sulphur mixture appreciably reduced the amount of spray necessary. It also greatly assisted in the formation of a film over the fruit, which was most difficult to secure without it. The authors' experimental work has shown, however, that, on most surfaces, casein-lime does not noticeably increase the proportion of spray retained unless prolonged drenching is practised. It may just as well be omitted from light or moderate applications.

Another recent development of some importance is the introduction of 'wettable' sulphur, made by adding casein-lime to very finely ground sulphur. This will be used extensively in eastern peach-growing districts as a substitute for self-boiled lime-sulphur. Probably only sufficient lime should be used to dissolve the casein (about twice the dry weight of the latter) as there are good reasons to suppose that lime itself sometimes causes injury by increasing fruit drop.

CHEVALIER (A.). **Sur une maladie de la Lavande cultivée.** [A disease of cultivated Lavender.]—*Rev. Bot. appliquée*, ii, 13, pp. 482–483, 1922.

In June 1922 the author found an interesting disease in a plantation of lavender (*Lavandula vera*), about 20 hect. in extent, situated at an altitude of 750 m. near the mouth of the Rhone. Both aspic (*Lavandula latifolia*) and true lavender (*L. vera*) occur in a wild form in the neighbourhood, and some plants of *L. fragrans* and *L. delphinensis* have been imported into the district.

The affected plants were found to be completely withered. On the surface of the large roots, bundles of white mycelial hyphae

could be observed, and similar hyphae were found invading all the underground portions of the plant. The fructifications of a small Agaric were found on one of the tap-roots on a slight protuberance near the collar. The fungus was identified by Patouillard as *Pholiota praecox*, a species which has not hitherto been known to cause damage to cultivated plants.

It is suggested that the disease may be controlled by thorough sanitation, including such measures as burning the affected plants and draining the low-lying parts of the plantation.

Revue bibliographique des travaux mycologiques publiées en 1920. [Bibliographical survey of mycological works published in 1920.]—*Bull. Soc. Myc. de France*, xxxviii (Supplement), 123 pp., 1922.

By means of a subsidy granted by the Fédération française des Sociétés de Sciences naturelles, the Mycological Society of France has arranged to publish an annual bibliographical survey of French and foreign mycological literature. The present fascicle, which is the first of the series, contains classified lists of mycological literature published during 1920. New genera and species are mentioned and brief abstracts are given of most of the papers cited.

Shear (C. L.). **Life-history of an undescribed ascomycete isolated from a granular mycetoma of Man.**—*Mycologia*, xiv, 5, pp. 239–243, 3 figs., 1922.

The author gives a short description, with a diagnosis, of a pleomorphic fungus which was isolated in 1921 by Dr. M. F. Boyd, Galveston, Texas, from a granular mycetoma in a human ankle, and was sent to him for identification. The lesion had lasted, with intervals of temporary healing, for about twelve years, and was the result of a wound inflicted by a thorn in the sole of the foot. As the fungus does not appear to be an anaerobic organism, it is not quite clear how it could live and develop within the tissues during the long periods when the wound was closed. Inoculation experiments with pure cultures conducted by Dr. Boyd on guinea-pigs were not successful in producing pathological effects of the mycetoma type.

The fungus develops readily on ordinary culture media, and in a few weeks produces all the spore forms. On cornmeal agar the colonies are white at first, then grey and with a radiate, fimbriate margin. As conidia develop the colour becomes greenish-ochre, then smoky brown. The first conidia are borne on loosely branched, byssoid hyphae, on short lateral or terminal sporophores. They are of the *Cephalosporium* type, with hyaline (later yellowish-brown), continuous, rather variable conidia, 8 to 15 by 4 to 7·5 μ, borne in groups at the tips of the conidiophores. Later a coremial stage of the *Dendrostilbella* type develops, with a dark brown synnema, 200 to 300 μ in height, and with a subglobose fertile head bearing conidia like those of the first form. Perithecia are found in numbers on the surface of the medium, and are globose, membranous, dark brown, without ostiole, and 100 to 200 μ in diameter. The asci are globose, thin-walled, evanescent at maturity, 8-spored, and measure 10 to 20 μ: paraphyses are absent. The ascospores

are globose or somewhat ovoid, continuous, smooth, pale yellowish-brown when ripe, and 7 by 7, or 5·5 to 7 by 4 to 4·5 μ.

The fungus is most closely related to the organism described by Costantin (*Bull. Soc. Bot. France*, xl, 2nd ser., 15, pp. 236–238, 1893) as *Eurotiopsis gayoni*, and renamed by Saccardo *Allescheria gayoni*. It is regarded as a new species, and named *A. boydii*, the names *Cephalosporium boydii* and *Dendrostilbella boydii* being given to the two conidial stages described.

Nelson (R.). **The occurrence of protozoa in plants affected with mosaic and related diseases.**—*Michigan Agric. Exper. Stat. Tech. Bull.* 58, 28 pp., 18 figs., 1922. [Received March 1923.]

This interesting paper records the occurrence of biflagellates in bean and clover plants affected with mosaic, and of trypanosome-like organisms in tomatoes with mosaic and potatoes with leaf roll. It is copiously illustrated with photomicrographs depicting the different organisms described and their situation in the tissues.

In a brief introductory summary the author alludes to the general belief in the filter-passing nature of the organisms causing mosaic diseases, to the recent discoveries by Matz, Kunkel, and Palm of foreign bodies in the cells of affected plants, and to the indication that the phloem is the region where the exciting cause is situated. He considers that there is little justification for the belief that filterable forms alone represent the stages of the parasites that are capable of producing these diseases, in view of the possibility that they are caused by protozoa, and the known extreme polymorphism of many of these.

The main object of the investigations was to determine if any organism could be demonstrated in the phloem tissue of mosaic plants. Bean mosaic was readily obtainable owing to the investigations of this disease carried on at the station for several years past. Clover and tomato mosaics were plentiful in the neighbourhood, while sufficient potato leaf roll for preliminary work was also available.

In all the early work the ordinary botanical methods were followed, but they revealed nothing. Protozoological methods, modified for plant material, were then adopted and applied to longitudinal sections, a departure from the customary technique of examining transverse sections which the author believes would have illuminated the mosaic problem if employed earlier.

In bean mosaic the sieve tubes were found to be remarkably free from staining particles, and to afford excellent material for study. Longitudinal sections of affected stems or petioles, fixed in various standard solutions of mercuric chloride and stained with Heidenhain's iron-alum haematoxylin, show the constant occurrence of biflagellate organisms scattered throughout the sieve tubes and phloem parenchyma. Tissues of healthy plants showed no such organisms.

Various forms have been observed in diseased tissues. (1) The most common type were large, elongated, tapering, or cigar-shaped individuals resembling *Leptomonas* in shape, but with two flagella, one at each pole. (2) Ovaliform biflagellates of the same type. (3) Deep-staining, slightly elongated, or almost spherical, sometimes

paired, bodies, surrounded by a lighter envelope which is penetrated by the flagella. (4) Very small, elongated flagellates, probably very young forms of type (1). (5) Deeply stained, oval bodies with degenerate flagella and outer envelope, perhaps encysted forms. (6) Small, elongated, non-flagellate bodies varying very much in size and occurring in great numbers in the degenerate chloroplasts of the subepidermal cells or filling the lumen of these cells.

Most of these flagellates lie close to the nucleus and parallel to the long axis of the host cell, although smaller forms sometimes lie obliquely. The flagella, which may be medial or slightly lateral, and which appear to be attached to deeply staining granules, are usually extended, but may be coiled round the nucleus. Degenerate nuclei are often found in diseased tissue.

The biflagellate forms divide by simple, longitudinal, binary fission. First the basal granules divide, next the flagella split, a V-shape slit appears in each end of the body, and division then occurs. Other forms of division probably exist, but have not been observed.

The organisms have been demonstrated in living material by cutting thin longitudinal sections through the phloem, mounting immediately in boiled water, and examining under high-power, dry lenses with minimum illumination. The flagellates were seen actively motile in the sieve tubes, whirling rapidly but without much displacement of position. Rarely more than one individual occurs in a cell, and many cells have none.

The juice expressed from short pieces of petiole was also examined as hanging drops under oil immersion lenses. Occasionally organisms were seen to flash across the field, but they were not located easily.

The size of the flagellates is very variable: type (1) ranges in length from 18 to 3 μ (average 13·5) and in breadth from 3·9 to 0·3 μ. The flagella may vary from 18 to 7·2 μ.

Mosaic of clover (transmissible from bean and vice versa) is also associated with the presence of flagellates of the same type as those found in bean mosaic. Non-flagellate forms were more frequent than flagellate ones, while besides type (1) the small biflagellate forms, and occasionally the broad form, found in the bean were also demonstrated.

No great difficulty was encountered in locating, in the sieve tubes of tomato mosaic material, organisms with a deep staining, long, sinuous, tapering body of trypaniform nature, with one or both ends drawn out to a fine point, and usually with one end larger than the other. The organisms hold haematoxylin tenaciously, and usually lie close to the nucleus. They are not so numerous as those in the bean, seeming to occur in 'nests', the larger forms undoubtedly splitting into a number of smaller individuals. Binary fission was observed in several cases, but only of small forms.

Besides the long, sinuous type of organism, shorter and broader forms also occur, while many show only a slight undulation and others are almost straight. The phenomenon of agglomeration (two or more organisms attached to each other by their posterior ends), common among trypanosomes, has been observed in the organisms in tomato mosaic.

In size the tomato organisms vary widely, the average being 15·3 by 2·8 μ. The largest individual seen was 27 by 6 μ, and the smallest 6·2 by 0·5 μ. The small forms have been seen passing through the perforations in the sieve plates. No definite flagella have been demonstrated, but an undulating membrane has sometimes been seen faintly stained and running nearly the entire length of the body. A nucleus can be made out in the centre of the organism, and deeply staining granules near the extremities.

In potato plants showing only leaf roll symptoms, long trypanosome-like organisms were found in the sieve tubes of the petioles and stems. They vary, but are nevertheless characteristic and constant for this disease. They tend to distribute themselves along only certain of the sieve tubes, but when present they usually occur in a succession of cells. They are frequently in intimate contact with the nucleus, although they may lie free in the cell, usually parallel to the long axis, or, in the case of the smaller forms, obliquely. In size they vary from 35 to 11·3 μ or less in length, and 3·0 to 0·9 μ in breadth, the average being 23·6 by 1·8 μ. The organisms appear to possess a distinct undulating membrane, especially in certain extremely sinuous individuals, and occasionally a long flagellum at one end of the body has been seen. Distinct, dark staining granules occur at each end of the body and are probably blepharoplasts.

In conclusion, the author discusses the nature of the organisms found, emphasizing their protozoon characters, and on the present evidence tentatively suggests that the bean and clover organisms belong to a new genus related to the species of *Leptomonas* found in the latex of Euphorbiaceae and Asclepiadaceae, but distinguished by the bipolar flagella, whilst the resemblance between the organism of tomato mosaic, and especially that of leaf roll of potato to trypanosomes, is unmistakable. As regards the ability of viruses to pass bacterial filters, some of the very slender forms of the bean flagellate might pass medium filters, and there is the possibility of 'symplastic' forms occurring in the life-cycle.

FRANCHINI (G.). **Essais d'inoculations aux souris blanches du latex parasité de différentes espèces d'Euphorbes.** [Inoculation experiments on white mice with parasitized latex from different species of Euphorbiaceae.]—*Ann. Inst. Pasteur*, xxxvi. 12, pp. 873–881, 1922.

Of about thirty mice inoculated in the peritoneum with the latex of various species of Euphorbiaceae containing trypanosomes and amoebae, only seven were slightly infected. The animals were subsequently destroyed, and an examination of the organs of the infected individuals revealed a few Leishmaniform or oval bodies, some provided with a short flagellum, while others contained several nuclei and centrosomes. The organs of a mouse inoculated with the latex of *Excoecaria emarginata* contained more protozoa than the others. The organisms were free or, rarely, intra-corpuscular. Cultures on Nöller's medium yielded a large number of protozoa of various kinds, especially some with pseudopodia and pronounced amoeboid movements. Phagocytosis of the red corpuscles occurred in some instances.

FRANCHINI (G.). **Essais d'inoculation au chat d'amibes du latex de plantes.** [Inoculation experiments on the cat with amoebae from the latex of plants.]—*Bull. Soc. Path. exot.*, xv, 10, pp. 931–933, 1 fig., 1922.

In the summer of 1922 three young cats were inoculated with cultures of amoebae from the latex of *Acokanthera venenata*, *Plumeria alba*, and *Ficus carica* respectively. In the two first cases slight infection resulted, with phagocytosis of the red corpuscles by some of the amoebae. Both the animals were indisposed for a short time. The third experiment gave entirely negative results.

These observations corroborate those of Musgrave and Clegg, who successfully infected two out of three monkeys at Manila with cultures of amoebae from lettuce leaves.

NISIKADO (Y.) & MIYAKE (C.). **Studies on the Helminthosporiose of the Rice plant.**—*Ber. Ohara Inst. landw. Forschungen*, ii, 2, pp. 133–194, 9 pl., 1922.

A brief historical account of the rice disease caused by *Helminthosporium oryzae*, which is common in Japan, is given. The first mention of a *Helminthosporium* on rice in Japan was made in 1895 by Miura, who attributed the disease to *H. macrocarpum* Grev. In 1901, however, Hori stated, as a result of his investigations, that the disease was caused by a new species, *H. oryzae* Miyabe and Hori. The present authors are satisfied that the fungus with which they have worked is identical with *H. oryzae* M. & H., and that Miura's species was the same. In 1918 Hara suggested that the name *H. oryzae* Breda de Haan should take precedence of *H. oryzae* M. & H. on grounds of priority, Breda de Haan's description having been published in Java in 1900. Although it has not been possible definitely to ascertain that the Java species is identical with that occurring in Japan, available data indicate that this is the case. The name *H. oryzae* Breda de Haan has therefore been adopted in the present paper. Apart from *H. macrocarpum*, which is sufficiently like *H. oryzae* to have led to confusion, but which differs in the size and shape of the conidia and conidiophores, there are two other allied species parasitic on rice, namely *H. sigmoideum* Cav. and *H. maculans* Catt., both of which, however, are easily distinguishable morphologically from *H. oryzae*.

The symptoms of the disease appear first on the foliage, whence they rapidly extend to all the aerial parts of the plant. Numerous small brown spots, the size of a pin's head and more distinct on the lower than on the upper surface, develop. The spots, which are first visible 24 to 48 hours after infection, gradually enlarge and become dark brown, measuring at this stage 1·5 to 2 mm. by 0·5 to 0·75 mm. in diameter, and being surrounded by a yellowish halo. They finally attain a length of 5 mm. and assume irregular shapes owing to coalescence. The central part of the spot turns grey, and heavily infected leaves gradually die back from the tip. The dead portions of the leaves have a velvety appearance caused by the conidiophores of the fungus. Seedlings are attacked as soon as they reach a height of 2 to 3 cm. The tips of the first leaves turn brown, and spots appear on the blades. In the authors' germination tests 12·5 per cent. of the seedlings were affected in

this way. Serious infection at an early stage results in a blight of the culms, which turn yellow and then dark brown, the surface being covered with velvety conidiophores. In such cases the heads are sometimes unable to emerge from the leaf-sheaths. In later infections, after the ears develop in the early autumn, lesions are observed on the lowest joint of the rachis, the brown or greyish-brown spots being up to 40 mm. in length. These neck lesions resemble those due to *Piricularia oryzae*, but may be distinguished from the latter by their lighter colour, velvety surface, and the wider curve of the infected head. On the glumes, the lesions generally begin near the joint of the outer and inner glumes, and spread over the entire surface. Infected glumes are covered with blackish-brown hairs.

The morphological characters of the fungus are fully described. On the host, the conidiophores are stout, erect hyphae arising in tufts of two to five or more, usually through a stoma, but sometimes through the epidermis or from mycelial hyphae on the surface of an infected grain or leaf. They are constricted at the point of passage through the epidermis or at the point of branching from creeping hyphae, and expanded into a swelling above the constriction. They are occasionally branched at the base, very slightly constricted at the septa, dark olive below and paler towards the apex, sometimes curved, and geniculate. Their size ranges from 68 to 688 μ in length, mostly from 172 to 473 μ. In width they range from 7·6 to 20 μ at the base, and the minimum and maximum number of septa observed were 2 and 26 respectively.

Conidia are produced singly on the tips of the conidiophores. They vary in length from 15 to 132 μ and in width from 10 to 26 μ, the mean being about 74 by 17 μ. They are generally obclavate, rounded at the basal end, attenuated towards the apex, and curved to one side, but they may be cylindrical or long elliptical and straight. The septa vary from 1 to 12 in number, and the colour from deep olive-buff to greyish-olive. The basal end of the conidium is marked by a small dark scar, where it was inserted on the conidiophore.

In culture the number of conidiophores and conidia produced by the various strains varied greatly. From one to ten or more conidia may be borne on the conidiophore. They attain their full size within two days. The cultural characteristics of the fungus on a number of different media are described at some length. Good growth was obtained from a culture two years and seven months old.

The results of inoculation experiments showed that a large number of grasses can be successfully infected by *H. oryzae*. In the authors' experiments and those quoted from other Japanese publications, some fifty species belonging to thirty-two genera were found to be susceptible. These included maize, sorghum, barley, *Coix lacryma-jobi*, *Panicum crus-galli*, *P. miliaceum*, *P. sanguinale*, *Eleusine indica*, *Setaria italica*, *S. glauca*, and *Cynodon dactylon*.

The mechanism of penetration was studied. It was found that the germ-tubes from germinating conidia are surrounded by a thick, mucilaginous sheath which causes the germ-tube to adhere to the epidermis of the host plant or, when grown in culture, to the glass. Appressoria are formed at the tips of the germ-tube within three

hours after germination. The tips swell up and become lobed or variously branched. Penetration can occur either through the stomata or through the cuticle and epidermal wall, by a thin infective hypha arising from the appressorium. The latter is often not well marked in the case of stomatal infections.

The optimum temperature for the germination of conidia was found to be between 25° and 30° C., the minimum and maximum temperatures being 2° and 41° respectively. The optimum temperature for mycelial development was 27° to 30° C. The thermal death point in ten minutes' exposures was 50° to 51° for conidia and 48° to 50° for the mycelium.

As the control of the disease by seed treatment has been dealt with in an earlier paper, only a brief discussion of the fungicidal effects of various substances on the conidia of *H. oryzae* is given. The following showed a comparatively high degree of efficiency: mercuric chloride, silver nitrate, copper sulphate, calcium hypochlorite, formaldehyde, and phenol. Particulars are given of the concentrations required in each case, and the length of exposure necessary for the destruction of the fungus.

SHARPLES (A.). **A consideration of recent work on the brown bast problem.**—*Malayan Agric. Journ.*, x, 6, pp. 155–170, 1922.

After a brief reference to the formation in 1918 of the Brown Bast of Rubber Investigation Committee in Malaya, the author gives a comparative résumé of the work done contemporaneously by the Committee in Malaya and by Rands in Java who, in many cases, followed parallel lines of investigation [see this *Review*, i, pp. 137–142].

In the course of experiments carried out by members of the Committee a large number of different organisms, a list of which is given, was isolated from tissues of *Hevea* affected with brown bast. The total failure, however, of numerous inoculation trials and attempts to transfer brown bast by transplanting and grafting diseased bark on to healthy trees, even though successful grafts were obtained, tends to support Belgrave's view, shared also by Rands, that brown bast is a non-infectious disease of physiological origin. Keuchenius has steadily supported the opposite view of a possible bacterial origin of the disease [see this *Review*, i, p. 263]. In this he is evidently much influenced by the results of experiments in which he made forty inoculations with bacteria isolated from the diseased tissues and kept forty controls. In both, discolorations progressing from the point of inoculation were obtained, the total length of the discolorations in the inoculated series being 177·5 cm., against 59·5 cm. in the controls. An analysis of these results shows, however, that twenty of the bacterial inoculations showed an increase in the length of discoloration as compared with the controls, while in sixteen there was no difference from the controls, and in the remaining four the length of discoloration was actually less than in the controls. The author therefore suggests as the only logical conclusion that such results cancel out and need not influence the work of other investigators. Furthermore Rands failed to get any positive results with bacteria supplied by Keuchenius, and the

various bacteria isolated from diseased bark in Malaya have equally failed to reproduce the disease.

A series of experiments set up by the Committee to test the comparative effect of tapping daily, on alternate days, and every third day on a full spiral, a half spiral, and a quarter cut, the results of which are given in tabular form, confirmed the evidence collected by Rands that heavy tapping raises the percentage of brown bast very considerably. The alternate day tapping resulted in much lower percentage of the disease than daily tapping, while tapping every third day gave still less. It was further observed that a single cut of extreme length, as for instance on a full spiral, gives similar results to a number of shorter cuts.

The evidence supplied by experiments carried out during a period of two years in Malaya, some details of which are given, does not support Rands's assumption that the resistance to brown bast sometimes observed in high-yielding trees, which he believes are generally the most susceptible to the disease, might be due to specific immunity, and that it might be possible by selection to breed a strain of *Hevea brasiliensis* immune to the disease. From the Malayan work it would appear that there is little relation between yield and the number of trees attacked by brown bast, though the progress of the disease is slow on bad soil (e.g. old tapioca land) where growth is poor and the cortex is tough. The existence of specific immunity is likely to be difficult to establish in view of the fact that general conditions of growth affect the percentage development of brown bast to a very great extent, and that the progeny of trees selected for their resistance may, therefore, vary in their susceptibility according to the set of conditions under which they are grown. Moreover, in seed selection as so far practised on rubber plantations, little attention has been given to the possibility of the male parent influencing the results.

The remainder of the paper is a short review of the methods of prevention and treatment of brown bast advocated in Malaya and elsewhere, and a consideration of the histological features of diseased tissues in which the opinion is expressed that too much importance has been assigned to the phloem changes observed by Farmer and Horne [see this *Review*, i, p. 144].

WAKSMAN (S. A.). **A method for counting the number of fungi in the soil.**—*Journ. of Bact.*, vii, 3, pp. 339-341, 1922.

The probable error involved in the determination of the numbers of soil fungi by the ordinary plate method is so great as to render the results quite worthless, the development of most of the fungi being prevented by that of the large number of bacteria on the plate when sufficient concentrations of soil to ensure the presence of fungi are used. The following synthetic medium has therefore been devised, its reaction being sufficiently acid to inhibit the development of the species of *Actinomyces* and the majority of bacteria: glucose 10 gm., peptone 5 gm., KH_2PO_4 1 gm., $MgSO_4.7H_2O$ 0·5 gm., and distilled water 1,000 c.c. Dissolve by boiling, add enough N/1 acid (H_2SO_4 or H_3PO_4) to bring the reaction to $P_H = 3·6$ to 3·8 (12 to 15 c.c. of N/1 acid per litre of medium). Add 25 gm. of

agar, boil, filter, run into tubes, and sterilize as usual. The final reaction should be $P_H = 4{\cdot}0$.

The soil should be diluted only one-fiftieth or one-two-hundredth as much as the dilutions used for the determination of bacteria (e. g. instead of a dilution of 1 to 200,000, 1 to 4,000 or 1,000 should be used), and plates are prepared in the regular way and incubated for 72 hours at 25° C. To obtain an accurate count and a low probable error ten plates should be prepared in each series. The colonies may be counted after 48 and again after 72 hours, by which time the spreading forms, occurring in soils rich in Mucorales, tend to overgrow the plate.

McWHORTER (F. P.). **The nature of the organism found in the Fiji galls of Sugar-cane.**—*Philippine Agriculturist*, xi, 4, pp. 103–111, 2 pl., 2 figs., 1922.

After a brief reference to the work of other investigators, the author describes successful preliminary attempts to cultivate the organism found in the galls of the Fiji disease of sugar-cane. Hanging-drop cultures were made in cane juice from thin sections containing the cysts of the organism. The percentage that germinated under such conditions was, however, very low, only about 2 per cent. giving really good germination.

The organism can first be demonstrated in the cells of the developing galls, where it appears in the form of irregularly shaped, lobed, amoeboid bodies, varying greatly in size and composed of granular protoplasm in which the granules are more or less equally distributed with little or no differentiation of ectoplasm. One to six bodies are present in each cell, three being a very frequent number. One (or sometimes more) is generally attached to the host nucleus and remains so until a fairly advanced stage in the life-history of the organism; in some cases, however, the host nucleus may disintegrate as maturity is reached. The larger individuals in the cells may fragment into several smaller ones or, more frequently, divide by a primitive mitotic division into two equal parts. Stained preparations of this stage show that the fragmenting bodies contain nuclei without any nuclear membrane and in a stage of chromidial fragmentation typical of amoebae. During this amoeboid stage the galls continue to develop. The division of the organism is accompanied by the division of the host nuclei; the latter being more frequently amitotic than mitotic. As the galls get older and their walls begin to thicken, the amoeboid bodies cease to divide: they then begin to show vacuoles in their cytoplasm, and finally all sizes round up into cysts. During the early stages of vacuolation, the small cysts resemble certain of the 'ring stages' developed by the sporozoa, and are strikingly similar in appearance to young *Entamoeba coli*. The author observed no indication that the large amoebae divide into a mass of spores. Each cyst is formed from a single amoeba, and since the amoebae differ in size, so do the cysts. The mature cyst is a hollow structure, composed of highly vacuolate protoplasm with a firm but not brittle wall.

Besides bearing galls, plants suffering from Fiji disease are dwarfed, and show other symptoms of disease. In such plants it is not difficult to demonstrate various forms of the organism in other

parts besides the galls. Partially encysted stages may be occasionally found in the metaxylem; the author has found them in the metaxylem of the roots in plants with a very typical reduced root system. In swollen places on these roots, which are really galls, the organism often occurs in abundance.

When germinating, the wall of the cyst softens, generally irregularly so that lobes are formed as in a moving *Arcella*. Then the granules composing the walls of the vacuoles are rearranged, and the cyst becomes transformed into a typical motile amoeba, with one or more slowly contractile vacuoles and both rounded and pointed pseudopodia. There is little differentiation into ectoplasm and endoplasm, but in all cases a distinct, highly refractive body, probably a nucleus, is present. Since each cyst changes into only one amoeba and each amoeba has a single nucleus, it is likely that the cysts are uninucleate, though this point requires further investigation. Although the wall of the cyst must contain much metaplasm, the organism was never observed, when germinating, to make any attempts to shed the wall, which becomes part of the motile amoeba's protoplasm. Movement is sluggish, and the amoebae show a tendency to become pointed in culture, though nothing resembling a flagellum has been seen. The amoebae that develop from the large cysts differ but little from the smaller ones, except in size. The maximum length observed was about 15 μ, but the average is only about 5 μ. When dividing, the smaller forms frequently assume a peculiar trypanosome-like shape. Figures showing the amoebae dividing into two of approximately equal size are given from cultures. Summing up, the life-cycle of the organism is simply amoeba—cyst—amoeba. The cysts represent a resting, non-motile stage in the life-history of the organism, and cannot be considered a method of reproduction.

Discussing the classification of the organism, the author states that it differs widely from the genus *Plasmodiophora* in showing no tendency to coalesce into a true plasmodium, in the absence of a zoospore stage, in the spores (cysts) being large, variable in size, and absorbing their membranes when germinating. Among the Chytridiaceae, the fungus *Asterocystis radicis*, causing flax root-blight, has spores that might be mistaken for cysts of the Fiji organism, but the fact that it reproduces chiefly by means of numerous swarm spores clearly differentiates it from the latter. The author concludes that the organism in the Fiji galls is an amoeba related by its characteristics and method of encystment to the section *Lobosa*, although he can find no previous record of such an organism parasitic on plants. The Fiji amoeba resembles *Entamoeba coli*, but differs from the genus *Entamoeba* by its nuclear behaviour and the germination of its cysts. Since there is apparently no existing genus wherein it may be placed, he proposes the generic name *Phytamoeba*. Lyon's name *Northiella sacchari* [see this *Review*, i, p. 187] is not accepted.

The following is the diagnosis of the organism: *Phytamoeba* g. nov. Small intracellular amoebae capable of living in a free state. Little differentiation of ectoplasm. Pseudopodia lobose, blunt. Reproduction by gemmation and simple fission. Cysts form in host cell. Each cyst develops into one amoeba. No zoo-

spores. *P. saccharí* sp. nov. Small intracellular amoeba, capable of living in free state. Size variable, seldom more than 12 μ. When intracellular, pseudopodia are lobose or pointed. Vacuoles present, more or less contractile in extracellular type. Nucleus organized or distributed. Cysts small, rounded, highly vacuolate, walls smooth. Cysts germinate into amoebae. Reproduction by gemmation and simple fission. No zoospores. No coalescing of amoebae to form large plasmodia. Host *Saccharum officinarum* Linn.

Inoculation experiments are in progress. With regard to the path of the organism there is evidence that it passes partly through the metaxylem and partly through certain cells of the pericycle lying between the xylem and phloem. This would help to account for the fact that the galls generally develop from that region of the pericycle. The author has little doubt that the disease is insect borne, though this important point remains to be demonstrated.

WILBRINK (G.). **Een onderzoek naar de verbreiding der gelestrepenziekte door bladluizen.** [An investigation of the transmission of yellow stripe disease by green-flies.]—*Meded. Proefstat. Java Suikerind.*, 1922, 10. [Reprinted from *Arch. Suikerind. Nederl.-Indie*, XXX, pp. 413–456, 1922].

After a preliminary account of the symptoms and distribution of yellow stripe or mosaic disease of sugar-cane, the author describes certain investigations and experiments bearing on Brandes's discovery that the disease is transmissible by insects from sorghum to sugar-cane and maize.

In January, 1921, attempts were made to get the disease to pass from sugar-cane, maize, and sorghum plants infested with *Aphis adusta* (*A. maydis*) to healthy sugar-cane plants, but all the experiments gave negative results. In January, 1922, however, *A. adusta* was again observed on young sugar-cane interplanted with maize, and the author found that by interplanting the cane with any of the favourite hosts of *A. adusta* the transmission of the disease could easily be secured. In addition to the hosts of *A. adusta* already enumerated in the literature [see this *Review*, ii, pp. 33–34], the following have recently been found: *Saccharum spontaneum*, *Dactyloctenium aegyptiacum* [*Eleusine aegyptiaca*], and *Pennisetum macrostachyum*. Under Java conditions the insects appear to prefer *Panicum colonum* to any other host.

A. saccharí attacks primarily the Black Cheribon, White Preanger, Black Borneo, and EK 28 varieties of sugar-cane, and, in contrast to *A. adusta*, inhabits by preference the older leaves. The only alternative host in Java appears to be sorghum, on which the insects are present in enormous numbers. A pink variety of *A. saccharí*, however, was also found to attack *Panicum colonum*.

In June, 1921, sorghum plants growing close to infected sugar-canes became diseased, and in the autumn of 1921 and 1922 further cases of infected sorghum were observed, both among the plants adjacent to diseased sugar-canes and in those planted next to diseased sorghum. Neither the infected sorghum plants nor the wild hosts were seriously affected by the disease, growth being unimpaired and the setting of seed normal. Maize interplanted

with diseased sugar-cane in December 1921 became infected in January 1922. The light and dark spots were small at first, but the former rapidly extended so that the leaves finally showed scattered green spots on a yellow or light green ground. Development was not appreciably impaired, and the seed of the diseased maize gave healthy plants, as was also the case with sorghum.

The results of a series of comparative experiments, in which infected and healthy sugar-cane seedlings were enclosed in cages with *A. sacchari* and *A. adusta*, respectively, showed that, in the case of the former, transmission of the disease from infected to healthy plants occurred only in one instance (the authenticity of which was questionable), while in the latter series transmission occurred very generally (100 per cent. of the healthy plants becoming infected in one case) and the rôle of *A. adusta* in the process was unmistakable. These results confirm the work of Brandes, and also show that the disease is transmissible from infected to healthy sugar-cane, as well as from sorghum to cane and maize.

The bearing of this work on the incidence and control of the disease is discussed at length. Damp and cloudy weather indirectly favours the propagation of *A. adusta* by promoting the growth in the cane fields of the wild grasses among which it finds so many hosts. Similar results are produced by light and fertile soils. Now that the infectious character of the disease has been fully established, the most stringent measures must be adopted to secure the cultivation exclusively of disease-free setts. The nurseries from which cane for planting out is obtained [see this *Review*, i, p. 187] should be carefully watched, and every case of the disease immediately removed and destroyed. The growth of grasses should be prevented in all nurseries. Susceptible varieties, if cultivated at all, should be restricted to absolutely isolated fields, but it is better, whenever possible, to replace them by resistant varieties, amongst which 100 P O J appears to be one of the best, while 247 B, E K 2, and E K 28 are also mentioned.

TANAKA (T.). **New Japanese fungi. Notes and translations. XII.**—*Mycologia*, xiv, 5, pp. 282–295, 1922.

This number of the series contains the diagnoses in English, together with notes, of several Japanese species of *Gymnosporangium* that have been described in publications written in Japanese. In each case the synonymy and full bibliographical references are given.

Gymnosporangium asiaticum Miyabe forms its teleuto stage on *Juniperus chinensis* and *J. chinensis* var. *procumbens* (*sargenti*) and the accidial stage on *Pyrus sinensis* and *Cydonia vulgaris*. The *Roestelia* form of this fungus (*R. koreaensis*) causes the very destructive rust of the Japanese sand-pear, but European pears suffer little from natural infection though they can be inoculated. Some Japanese authors mention *Pyrus toringo* and *Cydonia sinensis* as further hosts. *Gymnosporangium yamadae* Miyabe has its teleuto stage on the same hosts as the last, while the aecidial stage causes an apple rust that has menaced the apple cultivation of northern Japan. It also attacks *Pyrus spectabilis* and *P. toringo*. *Gymnosporangium idetae* Yamada is found in

the teleuto stage on *Juniperus rigidus* and in the aecidial form on *Amelanchier asiatica*. *Gymnosporangium hemisphaericum* K. Hara occurs on *Juniperus littoralis* (*J. conferta*) and *J. chinensis* in the telento stage and on *Pyrus sumi* in the aecidial. *Gymnosporangium shiraianum* K. Hara forms teleutospores on *Juniperus littoralis* and aecidia on *Pyrus sinensis*. Sand-pear cultivation in the Mikatagahara region had to be abandoned owing to the virulence of this rust.

The paper terminates with a synopsis of the Japanese species of *Gymnosporangium* hitherto recorded.

HARA (K.). **On Witches' Broom of the Sasa spiculosa.**—*Journ. Agric. Soc. Shizuokiken*, 300, 5 pp., 2 pl., 1922. [Japanese.]

A new witches' broom is described and figured on the *Sasa* bamboo. The English diagnosis is as follows: *Epichloe sasae* Hara n. sp. Stroma surrounding the young sheath, cylindrical or conical, pointed at the top, 1·5 to 4 cm. long, 3 to 5·5 mm. thick, black, pulvinate, hard when dry; perithecia immersed, elliptical or ovate, 250 to 350 μ high, 110 to 200 μ broad, with projecting ostiola; asci cylindrical, eight-spored, 200 to 250 by 6 to 7 μ; spores filiform, hyaline, 190 to 240 by 1 to 1·5 μ, septate at maturity, separating at the septa into short segments, 12 to 17 μ long. Hab. on *Sasa spiculosa* (Province Idzu, Nekko, 1922).

SOUTH (F. W.). **Regulations controlling the importation of plants into the Straits Settlements, the Federated Malay States, and Johore.**—*Malay Agric. Journ.*, x, 9, pp. 228–233, 1922.

The object of this article is to present in a concise form the various regulations controlling the importation of plants into the Straits Settlements, the Federated Malay States, and Johore. The regulations which have appeared at irregular intervals in different Government Gazettes are not readily accessible.

The entry into the Straits Settlements of the following plants is subject to control.

COCO-NUTS. The importation of all coco-nuts and other palms from Ceylon, Sarawak, and the Philippine Islands is prohibited. This regulation does not apply to nuts of the coco-nut or betel-nut palms or to the husks or oil of coco-nuts from Sarawak. Dried copra and oil of coco-nuts from the Philippine Islands are also exempt from control.

RUBBER. The landing in the Straits Settlements of any plant of Pará rubber (including all species of *Hevea*) from any place outside the Colony is prohibited, except with the written permission of the Secretary for Agriculture, S. S. and F. M. S.

SUGAR-CANE. The importation of sugar-cane (*Saccharum officinarum*) from any place outside the colony is prohibited except under the following conditions: (1) All shipments shall be confined to material for planting purposes only and shall be accompanied by a certificate, signed by a competent authority of the country of origin, to the effect that the said material was taken from healthy plants and was, as far as could be ascertained at the time of packing, free from pests. (2) All shipments of cane plants shall be inspected on landing and before delivery by an Inspecting

Officer who shall be empowered to destroy any diseased plants or packing materials, or to order their disinfection, at his discretion. (3) All imported cane plants shall be quarantined in nurseries, from which they shall not be removed without the written permission of an Inspecting Officer.

In the Federated Malay States and Johore, the plants of which the importation is controlled include only Pará rubber and sugar-cane and the regulations are identical in substance with those of the Straits Settlements.

The author points out that the rules at present in force do not ensure adequate control over the importation of plants. Cotton and possibly other plants should be added to the list, and cocoanuts should not be allowed free entry into the Federated Malay States and Johore. Without unduly interfering with trade, it is most important to safeguard valuable cultivations from the danger of new pests introduced with commercial consignments from other countries. The Agricultural Department is now in the habit of requesting permission for its inspectors to examine any new plants likely to be grown on a commercial scale in the Straits Settlements or Federated Malay States, in order to ensure that the imported plants are healthy. It is hoped to secure further improvements in the present rules in the near future.

Restrictions on import of plants and seeds into India.—*Agric. Journ. of India*, xvii, 5, pp. 511–515, 1922.

By Notification No. 580–240, dated 26th June 1922, in supersession of that of 7th November 1917, of the Government of India in the Department of Revenue and Agriculture, the importation into British India of any living plant or part thereof by means of letter or sample post is prohibited, with the exception of sugar-cane for planting intended to be grown under the personal supervision of the Government Sugar-cane Expert, Coimbatore. All plants coming by sea, other than fruits and vegetables for consumption, potatoes, and sugar-cane, must be fumigated with hydrocyanic acid at one of the prescribed ports, namely, Bombay, Calcutta, Danushkodi, Karachi, Madras, Negapatam, Rangoon, and Tuticorin; plants infested with living parasitized insects and intended for the introduction of such parasites are exempted from this fumigation if accompanied by a special certificate from the Imperial Entomologist to the Government of India. Potatoes imported by sea must be accompanied by a certificate from the consignor stating fully the country and district in which they were grown and guaranteeing the absence of wart disease [*Synchytrium endobioticum*] from the farms of production, and by an official certificate that no case of wart disease of potatoes has been known during the twelve months preceding the date of the certificate within five miles of the place where the potatoes were grown. Importation of rubber plants by sea is allowed only if they are accompanied by an official certificate that the estate from which the plants originate or the individual plants are free from *Fomes semitostus* [*F. lignosus*], *Sphaerostilbe repens*, and *Fusicladium macrosporum* [*Melanopsammopsis elvi*]. Sugar-cane from any country other than the Fiji Islands, New Guinea, Australia, and

the Philippine Islands (from which the importation is prohibited absolutely) may be imported by sea only if accompanied by an official certificate that it was examined and found free from cane borers, scale insects, aleurodes, any form of root disease, pine-apple disease (*Thielaviopsis ethaeticus*), sereh, and cane gumminosis, that it was obtained from a crop free from mosaic, and that the Fiji disease of sugar-cane does not occur in the country of export; if the sugar-cane is imported direct by the Government Sugar-cane Expert, Coimbatore, or by the Agricultural Chemist, United Provinces, and intended to be grown under their personal supervision, such certificates shall be required only in respect of the Fiji disease.

The importation of coffee and *Hevea* rubber plants and seeds by sea from America (including the West Indies), except by the Madras Department of Agriculture, is prohibited. Flax and 'bersim' (Egyptian clover) seeds are not to be imported unless under a licence from a Department of Agriculture in India. Cotton seeds imported by sea must be fumigated with carbon bisulphide at a prescribed port as above. A schedule is appended giving the authorities in the exporting countries empowered to issue the official certificates referred to in the Notification.

Modification of nursery stock, plant and seed quarantine. Amendment No. 1 to regulations supplemental to notice of quarantine No. 37 (revised).—*U.S. Dept. Agric. Fed. Hort. Board Leaflet*, 2 pp., 1922.

As a result of representations made by the nursery trade, the regulations requiring that the roots of all plants imported into the United States should be freed from sand, soil, or earth 'by washing' has been modified to read 'by washing or other means'.

It was found that the washing of plants in the country of origin sometimes resulted in injury, and it has been agreed that the earth may be removed by shaking or other means in such cases.

Any importation not satisfactorily cleaned from sand, soil, or earth by some means will be refused entry.

Prohibition of importation of Sugar-cane in Guadeloupe and Martinique. - *Agron. Colon.*, vii. 57, p. 307, 1922.

A decree of the Minister for the Colonies, dated 16th August 1922, and published in the *Journal officiel de la République française* of 24th August 1922, prohibits the entry into, and transit across, Guadeloupe and Martinique of plants, cuttings, and seeds of sugar-cane of whatsoever origin. [In the preamble it is stated that this measure is taken chiefly because of the danger of introducing the mosaic disease of sugar-cane.]

In the interests of the colony, however, the Governor is at liberty to authorize the importation of plants originating in countries from which he is satisfied that there is no danger of infection.